NASA MAGAZINE

summer 1992

International Space Year

Dan Goldin becomes NASA's 9th administrator

Daniel Goldin, accompanied by his wife Judith and Vice President Dan Quayle, is sworn in as NASA's 9th Administrator by President Bush in the Oval Office.

"I can't tell you what an honor this is for me and how happy I am to come back to NASA. Over 30 years ago I sat down with my father and we filled out an application for the Lewis Research Center that started my career in civil space, the civil space program, and my membership on the NASA team.

To me, NASA is a symbol of America's competitive economic spirit...an investment in America's future...(and) the standard by which all other nations of the world measure their space programs. With your help, I intend to raise our standard even higher."

Administrator Daniel S. Goldin

Address to NASA Employees

April 1, 1992

CONTENTS

summer 1992

features

12
HAPPY BIRTHDAY, LANGLEY!
NASA's eldest celebrates its 75th anniversary.

20
HEAVY METAL
It's a rocket! It's a plane! No, actually it's a souped-up NASA hot rod.

30
SHEDDING NEW LIGHT ON LOW VISION
"Space glasses" derived from NASA technology offer hope to millions of Americans for whom ordinary eyeglasses don't help.

26
TAKING THE MEASURE OF MARS
The Mars Observer goes for the big picture.

32
A DEFINING MOMENT
James Michener voices his thoughts on the importance of space exploration.

departments

2 Spectrum

8 ISY Watch

9 Inside the Beltway

10 Down to Earth

11 Off Hours

34 Center Select

36 As I See It

37 Countdown

Cover: A scale model of a Republic RF-84F Thunderflash is tested in LaRC's 19-foot pressure tunnel during the 1950's. After renovation, the tunnel became the transonic dynamic tunnel in 1960 and today continues to test aeroelastic phenomena. Cover photo and all photos for LaRC birthday story (see page 12) courtesy of LaRC.

NASA MAGAZINE

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NASA MAGAZINE is published quarterly by the National Aeronautics and Space Administration for the information of the Agency's employees. Contributions and comments are solicited from Headquarters and all field centers, and should be addressed to Editor, NASA MAGAZINE, Internal Communications, Code P-2, NASA Headquarters, Washington, DC 20546.

NASA MAGAZINE is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402

NASA MAGAZINE is printed on recycled/recyclable paper.

Goldin, during a press conference at Johnson on May 11.

Goldin Meets the NASA Team

No sooner was Dan Goldin on the job than he began making the rounds, acquainting himself with NASA's centers. Within two days of his appointment as NASA Administrator, he visited the Kennedy Space Center to get a firsthand look at the Space Shuttle fleet in action, with the April 2 landing of Atlantis at the Florida Shuttle Landing Facility. "I've been to Shuttle launches before," said Goldin, "but I've never seen one land. It was an emotional experience."

Goldin put the NASA "meatball" insignia back into service while visiting Langley on May 22.

At the Stennis Space Center on April 14, the administrator toured several facilities, and was briefed by key personnel on the center's current and upcoming programs. He also was the guest of honor at a reception attended by Stennis employees.

The Marshall Space Flight Center hosted Goldin on April 21, providing tours of the Project LASER Discovery Lab, the Productivity Enhancement Complex, and the U. S. Space and Rocket Center. Goldin addressed Marshall employees at a luncheon honoring secretaries and clerical personnel at the Redstone Arsenal Officers' Club.

Then it was back to Ohio, where Goldin had first worked for NASA 30 years ago. The new administrator visited the Lewis Research Center on April 22, touring several facilities and meeting with a cross-section of employees throughout the center. He challenged all Lewis employees to focus on how they can personally improve and measure their contributions to NASA.

On Thursday, May 28, Goldin visited the Jet Propulsion Laboratory where he challenged JPL employees to "strengthen ourselves and take risks…and yes, it is safe to take risks at NASA again."

On the final leg of his center tours, Goldin visited Goddard in June and plans to visit Ames Research Center and the Dryden Flight Research Facility in July.

Goldin gets a closeup look at a Space Shuttle at Kennedy.

Mary Rose Palfy talks to Goldin about Lewis's system for processing invoices.

Goldin as guest of honor at a reception attended by all Stennis employees; with him is center Deputy Director, Gerald Smith.

Youth participating in Space Camp at the U. S. Space and Rocket Center meet Goldin during his Marshall visit.

The STS-45 crew was joined by an orbiting Oscar to pay tribute to George Lucas at the Academy Awards ceremony in March.

The space Oscar returns to its earthly home at the Academy of Motion Picture Arts and Science's Center for Motion Picture Study on May 27. Left to right: Gil Cates, producer of the Oscar telecast; STS-45 commander, Col. Charles Bolden; Administrator, Daniel Goldin; Academy President, Karl Malden; STS-45 crewmembers David Leestma with space-faring Oscar, and Brian Duffy.

An Oscar...

The biggest trick was getting Oscar ready for his trip to space. But after months of coordination and planning, the famous statuette's debut from low Earth orbit brought the house down during the Academy Awards ceremony in March.

NASA was first approached by the Academy of Motion Picture Arts and Sciences in the fall of 1990 with a request to consider flying one of its award statues onboard the Space Shuttle. The goal was to tie Oscar and the space program together for a tribute to filmmaker George Lucas, the recipient of this year's Irving J. Thalberg award for significant contributions to the motion picture arts and sciences.

Speaking for the STS-45 crew who flew with Oscar, Commander Charlie Bolden praised Lucas for exciting young people about space travel with his films. In accepting his award, Lucas thanked his teachers for inspiring him to pursue his dreams.

The space Oscar, having traveled nearly 4 million miles aboard Space Shuttle *Atlantis*, was returned home to the Academy of Motion Picture Arts and Science's Center for Motion Picture Study at a ceremony in Beverly Hills on May 27.

...and an Emmy

Linda Dukes-Campbell, now Lewis Research Center's chief of Community and Media Relations, was part of a team awarded a national Emmy recently for a program produced at WEWS in Cleveland. Dukes-Campbell, who worked at the station until last September, was associate producer of "Color-Blind," the one-hour kickoff to the station's year-long anti-prejudice and awareness campaign called "World of Difference."

In a day-long sensitivity session—part of a conference hosted by WEWS to foster awareness of racial

Linda Dukes-Campbell

prejudice— participants explored attitudes about race, sex, and age. This was followed by another session a month later. More than 12 hours of videotape were edited for the "Color-Blind" special, which received the Community Service Emmy Award last September from the National Association of Television Arts & Sciences. Although the station had previously won many local Emmys, this was their first national award.

Dukes-Campbell said the special was probably the most powerful piece of journalism ever shown by a Cleveland television

station. "It awakened a lot of feelings in the viewing audience. Everyone says, 'I am not a bigot.' Yet as this special showed, they perpetuate racism in subtle ways."

In her job at Lewis, Dukes-Campbell says her biggest challenge is to educate the local community about operations at NASA and to dispel the misconception many people have about government workers. "The work that people are doing here is phenomenal," she says. "These people work so hard!"

Long Ago and Far Away

Ames Research Center and NASA celebrated the 20th anniversary of the Pioneer 10 spacecraft on March 2. Launched from Kennedy Space Center onboard an Atlas-Centaur rocket in 1972, Pioneer 10 is now beyond the orbits of all the planets, having traveled more than five billion miles from Earth.

With its planetary investigations long finished, the spacecraft is exploring the region of the Sun's extended magnetic field and electrical field known as the heliosphere. Pioneer

ENDEAVOUR

One For the Record Books

By the time the drama ended, a satellite had been repaired, a new spacewalk record had been set, and the nation, in the words of one newspaper account, "had a new set of heroes."

Endeavour roared off Launch Pad 39B on its inaugural STS-49 mission May 8 to rescue the Intelsat 6 spacecraft and practice assembly methods for Space Station Freedom. The mission, which finally was successful in capturing and repairing Intelsat after three tries, broke almost every spacewalk record, including the most ever—four—on a single flight. The third spacewalk was the first ever by three astronauts, and was the longest extravehicular activity (EVA) in history, surpassing even the walks taken on the surface of the Moon by the Apollo astronauts.

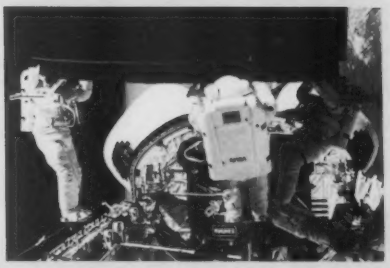
During the rescue phase, astronaut chief and mission commander Dan Brandenstein three times maneuvered Endeavour up to the Intelsat, the last time literally placing the satellite into the hands of Pierre Thuot, Richard Hieb and Thomas Akers. After grabbing the errant spacecraft, the three spacewalking astronauts then fitted it with a new booster motor so that it could climb to its proper geosynchronous orbit.

A fourth spacewalk after the Intelsat rescue allowed Akers and Kathryn Thornton to practice space station construction tasks. During the flight, the

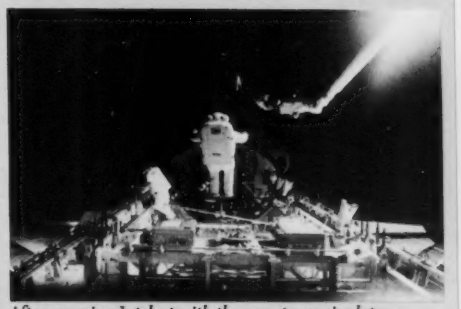
STS-49 Endeavour crew: Left to right (front) Kathryn C. Thornton, Thomas D. Akers, and Richard J. Hieb; (back) Pierre J. Thuot, Daniel C. Brandenstein, Kevin P. Chilton and Bruce E. Melnick.

This scene of Intelsat VI greeted the STS-49 crewmembers as they prepared for their successful capture of the errant satellite.

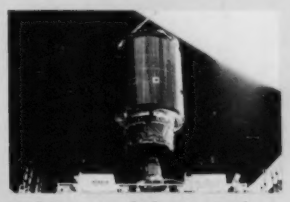
Thuot's second-day unsuccessful attempt to affix the grapple bar to the 4.5 ton Intelsat.



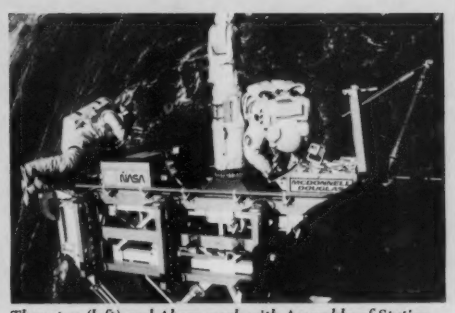
◄ *Left to right, Hieb, Akers and Thuot have handholds on Intelsat VI, as they successfully capture the satellite.* ▼



After securing Intelsat with the remote manipulator system, the crew prepares the satellite for release into orbit.



With its perigee kick motor in place, the Intelsat VI satellite spins slowly away from Endeavour's cargo bay.



Thornton (left) and Akers work with Assembly of Station components on the mission's fourth EVA.

crew noted that based on their experience in grappling the Intelsat 6, training for space station assembly will have to undergo some major changes.

Throughout the crew's travails, the performance of the nation's newest orbiter was flawless. The mission was extended twice and finally landed at California's Edwards Air Force Base on May 16.

After the successful satellite capture, President Bush and Vice President Quayle both phoned in their congratulations to Administrator Goldin, conveying, in Goldin's words, "every confidence in NASA to carry out bold research and exploration programs."

Later Goldin said of Endeavour's triumphant first mission, "Your achievements reflect the can-do attitude of the NASA of old and the new NASA of today." •

10 was the first craft to cross the asteroid belt and the first to fly past Jupiter—providing the first close images of the Solar System's largest planet. The 568-pound spacecraft, currently the most distant object built by humans, has enough velocity to escape the gravitational pull of the Sun. In the odd event that some other group of interested beings ever finds it, Pioneer 10 carries a plaque showing a representation of a man and a woman standing beside a likeness of the vehicle. The plaque, which is "written" in visual and binary code, also depicts our Solar System as the point of origin for the spacecraft's journey.

Three of NASA's four deep space vehicles are now heading toward the center of our galaxy, with Pioneer 10 heading in the opposite direction. All four are beyond Pluto, which is presently inside the orbit of Neptune. This three-dimensional spacecraft arrangement will help the space physics community in their continuing search for the edge of the Sun's influence—the heliopause—and the beginning of true interstellar space.

The Pioneer spacecraft is managed and controlled by Ames.

A Tomato is a Tomato is a...

Are "space seeds" different from ordinary seeds? NASA has analyzed the results of tomato seed experiments performed by more than 3.3 million students under the supervision of nearly 64,000 teachers. The seeds, which were flown aboard the Long Duration Exposure Facility for almost six years before being retrieved in January 1990, were distributed by NASA education offices as part of a student experiment to see if space-exposed seeds germinate and grow differently from ordinary Earth seeds. The results, published in April, are based on 8,000 reports. They suggest that the space-exposed seeds germinated faster and experienced a faster initial growth rate, but overall produced no noticeable difference in the fruit.

COBE Finds Structure in the Void

A major cosmological advance was announced in April by scientists using data gathered by the Cosmic Background Explorer (COBE). The scientists—George Smoot of the University of California at Berkeley, Charles Bennett of NASA's Goddard Space Flight Center, Edward Wright of UCLA, and others—announced they have detected the long-sought variations in the background radiation left over from the Big Bang. These variations show up as temperature fluctuations of only about thirty millionths of a degree Kelvin in different regions of the sky. The team's findings agree with the postulated "inflationary cosmology" theory for the origin of the Universe, which states that the structure and behavior of the Universe were determined by minute fluctuations less than one-trillionth of a second after the Bang. The amount of gravity determined by the COBE results to have existed at that primordial moment would not have been adequate to cause the creation of galaxies or clusters, lending support to the so-called "dark matter" theory, which holds that there is much material in the Universe that we have yet to detect.

Thirty Days Under the Sea

The Johnson Space Center's Behavior and Performance Laboratory is cooperating with the Marine Resources Development Foundation in Key Largo, Florida, on an experiment involving four men living for 30 days in an undersea laboratory. Because the crew will go on daily excursions to collect ocean research data, the experiment provides an analog to a lunar or Martian laboratory where teams also would make periodic forays outside to gather samples. The JSC laboratory will be studying the health and well-being of the men, including such factors as cognitive functioning ability and stress. The crewmembers' perceptions of work organization and general behavioral observations also will be recorded. JSC expects that this experiment will give a better understanding of the viability of certain procedures, as well as hardware and software that could be used for 30-day space missions. •

TRANSITION

Honored

For the second year in a row the Johnson Space Center has the distinction of employing the NASA Inventor of the Year. This year three JSC recipients—**P. David Wolf, Ray Schwarz,** and **Tinh Trinh**—are being recognized for their contributions to the development of a new class of tissue culture growth system. The trio worked on the design of the JSC bioreactor, which uses a slowly-rotating cell wall to stimulate the growth of tissue that is more like normal. This year the JSC team shares the Inventor of the Year award with a team from the Marshall Space Flight Center. Engineers **William Simpson, Max Sharpe** and **William Hill** were honored for their Sprayable Lightweight Ablative Coating, which is used to spray the Space Shuttle's reusable solid rocket boosters. The Marshall and Johnson inventor teams were toasted at the NASA Award Ceremony this March in Washington.

The National Space Club awarded the Goddard Trophy for 1992 to the **Magellan** project for the mission's success in mapping Earth's twin planet with unprecedented resolution and nearly complete coverage. The award was presented at the Club's annual Goddard Memorial Dinner.

Died

James E. Webb, NASA Administrator from 1961 to 1968, died in March after a heart attack. He was 85. Webb was universally credited for laying the groundwork for the success of the Apollo program, and during his tenure, the agency grew to include 35,000 staff members and about 400,000 contractors.

Thomas Otten Paine, NASA's third Administrator and a principal architect of this nation's space program, died of cancer at his home in Los Angeles on May 6. Paine, who led NASA during the Apollo lunar mission era, was 70. President Johnson appointed him as NASA Deputy Administrator under James Webb. When Webb retired in 1968, Paine became Administrator.

Changing Jobs

Associate Administrator for Space Flight **William Lenoir** resigned in May. Administrator Goldin named Major General **Jeremiah W. Pearson, III**, of the U.S. Marine Corps, as the new Associate Administrator for Space Flight. Goldin also named astronaut **Bryan O'Connor** as Deputy Associate Administrator for Space Flight.

Goldin also announced the appointment of astronaut **Charles Bolden** to be Assistant Deputy Administrator, responsible for integrating and ensuring the accomplishment of Total Quality Management review activities across the agency.

Darleen Druyun was appointed in May as Goldin's Chief of Staff. Goldin said "NASA intends to be world class in everything we do, and I view this appointment as being truly world class." Druyun's deputy, **Don Bush**, replaced her as Assistant Administrator for Procurement.

Laurie A. Broedling has been named as Associate Administrator for Continuous Improvement. She comes to NASA from the Department of Defense where she most recently served as the Deputy Under Secretary for Total Quality.

Astronaut **Fred Gregory** has been named by Administrator Goldin as the Associate Administrator for Safety and Mission Quality. **George Rodney**, who had been in this position since August 1986, retired in June.

Charles Pellerin, Jr. has been appointed as Deputy Associate Administrator for Safety and Mission Quality. In addition, Pellerin will work with recently announced Assistant Deputy Administrator Charles Bolden to assist Goldin in long-range planning.

Dr. Harriett Jenkins, Assistant Administrator for Equal Opportunity Programs at NASA since 1974, became the first Director of the Senate's Office of Fair Employment Practices on June 1. •

From conferences to training workshops to student rocket launches, International Space Year activities are taking place all over the world this summer.

University students in a NASA Life Sciences Training Program session test the reactions of a subject.

Up and Running

by Danelle K. Simonelli

Exciting things are happening in mid-1992 as the celebration of International Space Year continues. Global scientific projects initiated for ISY are now coming to fruition, and a wide variety of educational activities also are taking place:

Conferences: The ISY World Forest Watch Conference held from May 26 to May 29 in Brazil brought together scientists from around the globe to focus on the use of space technologies in monitoring deforestation. The next major ISY conference, the World Space Congress, will be held August 28-September 5 in Washington, D. C., when results of numerous ISY research projects will be presented. NASA will have a major exhibit there as well as several smaller exhibits, including a 50-ft. mockup of the National Aero-Space Plane, and plans to host the annual meeting of the Space Agency Forum on ISY (SAFISY), the international space agency coordinating group for ISY, in conjunction with the World Space Congress.

Many scientific and professional organizations also dedicated meetings to ISY, among them the May 26-29 International Geoscience and Remote Sensing Symposium in Clear Lake, Texas, and the May 30-June 4 International Conference on Engineering, Construction, and Operations in Space, held in Denver. Upcoming events include the August 2-14 Congress of the International Society for Photogrammetry and Remote Sensing in Washington, D.C., and the August 24-29 Planetary Congress of the Association of Space Explorers, also in the nation's capital.

Earth Science: A major theme of ISY is the Mission to Planet Earth, and several SAFISY Earth science projects already are showing results. NASA, which leads SAFISY's Greenhouse Effect Detection Experiment, recently released two of the project's CD-ROM disks containing data on the temperature and composition of Earth's atmosphere. Another innovative SAFISY effort, led by Canada's space agencies, is the GEOSCOPE Global Change Encyclopedia, the first interactive computerized encyclopedia of planet Earth, which recently premiered in prototype form.

Continuing through the year are a variety of SAFISY and United Nations training programs designed to help scientists in developing countries use satellite data in such areas as urban planning and the prediction of floods and earthquakes. The United States will host a U.N. conference in this series August 17-20 in Boulder, Colorado.

Educational Activities: The ISY Global Change Education Conference, co-sponsored by NASA, brought together educational, environmental, and civic leaders in Washington, D.C., on May 13. NASA's Space Life Sciences Training Program for university students, with expanded international participation for ISY, is ongoing at the Kennedy Space Center through the end of July.

Younger students met from March through May at sites across the United States to build "Marsville—the Cosmic Village," courtesy of the Challenger Center. Student rocket launchings, sponsored by the Rocket Research Institute and its counterparts worldwide, are continuing through the summer, highlighted by an international meet in Mourmelon, France, from July 23 to July 27. The International Space University will celebrate ISY by announcing plans for its permanent campus in conjunction with the World Space Congress.

These events are just some of the worldwide ISY activities this summer. Look for fall highlights and more upcoming events in the next issue of *NASA Magazine*. •

Danelle Simonelli is Information Director for the U.S. International Space Year Association.

For more information on these and other ISY projects, contact the U.S. International Space Year Association at (202) 863-1734.

This year's Congressional election may send as many as 150 new faces to Washington—most of whom will be eager to make good on their anti-incumbent, anti-big-spending campaign promises. From NASA's point of view, the result could be a hard job made even harder.

Changing of the Guard

by Dr. John Lawrence,
Office of Legislative Affairs,
NASA Hq.

There's an element of magic in this year's election. As stage magicians use misdirection to make us look away from the significant action, so the glamour of the Presidential election is diverting our attention from what could be the most momentous Congressional contest in modern history.

In 1948, 118 seats changed hands in the Congressional election—the modern day record. However, a confluence of circumstances this year could result in a turnover of up to 150 or more seats. A change of this magnitude would have far-reaching consequences for the nation and for NASA.

Three major factors contribute to the expected high turnover: redistricting, a high rate of retirements and resignations, and anti-incumbent sentiment.

The redistricting as a result of the 1990 census will affect Congressional delegations in 43 states. Four states having NASA centers are favorably affected—California gains seven seats; Texas, three; Florida, four; and Virginia, one. Ohio, which is home to the Lewis Research Center, loses two seats. Some redistricting plans are still pending court approval, but estimates are that the next Congress (the 103rd) could have 20 new minority members. And in at least five cases, redistricting will set incumbents against each other.

Others are leaving Congress of their own free will. As of early May more than 50 members had announced their resignation or retirement, and more were anticipated. Already it's the highest number of resignations since the end of World War II. Of this group, thirteen have declared their intention to run for other offices (11 for the senate, two for governorships). Of the remainder, many have cited frustration with the system or pressures of the job as motivating influences.

Another contributing factor to the wave of resignations is a new rule dictating how PAC (Political Action Committee) money can be disbursed. Over the course of a Congressional career, donations to a member's re-election fund can produce a significant war-chest, and this is the last year departing members can convert this money to their own personal use. In subsequent years, campaign fund balances must go either to charity, other PACs or a political party.

Those members of Congress who intend to run for re-election face a national anti-incumbent mood precipitated by the sluggish economy, the growing deficit and the back-to-back revelations concerning unpaid bills at the Capitol restaurant, allegations of embezzlement and drug dealing at the House post office and check over-drafts at the House bank. Evidence of this mood already was apparent in the spring, by which time 12 incumbents had been defeated in primary elections. This is an extraordinarily high number, especially for so early in the process. By comparison, only one incumbent lost a primary in 1990, one in 1988, two in 1986, and three in 1984. Consequently, some incumbents may expect meaningful opposition in the remaining primaries as well as in the general election in November.

Members of the 103rd Congress will have ample motive to regard themselves as instruments of reform. Newcomers to office as well as returning incumbents will likely have campaigned on fiscal austerity and anti-Washington themes.

From NASA's point of view, the result could be a hard job made even harder. The membership of NASA's committees of jurisdiction surely will change, and voting patterns in the overall body may shift. Of the members already known not to be returning, nearly two-thirds voted with NASA to restore Space Station *Freedom* funds to the Fiscal Year 1992 appropriation. *Freedom* was saved by a margin of 67 votes—meaning a swing of 34 votes would have had the reverse effect. With more than a hundred new members predicted, the 103rd's freshmen would be a highly influential bloc.

Accordingly, NASA's early objective will be to educate the new members of the 103rd, and to preserve and strengthen the collegiality that exists with its committees of jurisdiction.

To do so, NASA may have to work some magic of its own.•

With some clever image enhancement provided by technicians at the Kennedy Space Center, Pennsylvania police were able to convict a murderer based on a few fuzzy frames captured on film at a bank teller machine.

Scenes of the Crime

by Mitch Varnes, KSC

NASA is known for discovering clues to the mysteries of the universe, but high-tech imagery and a group of dedicated Kennedy Space Center security officers recently joined forces to help police solve the murder of a Northumberland County, Pennsylvania woman.

On May 24, 1989, 19-year-old Lori Auker, of Point Township, Pennsylvania, disappeared while on her way to work at a local shopping mall. Auker's car was found in her usual parking space at the mall, but she never arrived at her destination. Authorities spent nearly three weeks looking for leads and scouring the countryside before Auker's body was discovered at a county landfill 19 days after her disappearance.

Police initially suspected that Lori's former husband, Robert, was involved in both her disappearance and death, but had no way of proving it. On a hunch, investigators requested the film from the camera of an Automatic Teller Machine (ATM) located several yards from where Lori had parked her car. A series of three black and white photographs taken just 13 minutes before Lori was due at work showed a bank customer in the foreground and some unusual occurrences in the background. Fuzzy and almost indistinguishable, the three images—snapped over a 20-second period—captured a car entering and leaving the camera's field of view. The second picture showed a female form matching Lori Auker's standing outside the passenger side. More importantly, the car in the photo appeared to be similar to a car owned by Robert Auker's father, a 1984 Chevrolet Celebrity that was sold only a couple of days after Lori was reported missing.

The search for the Chevrolet took longer than expected, but eventually it was recovered. When police went back to the shopping mall and recreated the scene using the ATM surveillance camera and the recovered car, the cars in the two films appeared nearly identical.

Pennsylvania police then spent months working with image specialists at the FBI and Eastman Kodak Company in attempts to further refine the original three frames. Their efforts proved helpful, but the results weren't incriminating enough to warrant an arrest.

Pennsylvania state police officer Tom Brennan then steered Northumberland District Attorney Robert Sacavage and detective George Allen to the Kennedy Space Center, where NASA uses computer enhancement of photographic images to provide detailed visual information of Space Shuttle and other rocket launches. The space agency also uses the technique to aid scientists in studying photographic images taken by planetary spacecraft, such as those that recently mapped Venus and returned the first closeup images of the asteroid Gaspra.

Allen and Sacavage subsequently traveled to the Florida spaceport with the ATM films in hand. There, Andy Casey, a security officer for EG&G Florida, KSC's base operations contractor, and fellow space center worker Al Tietjen took the films to a laboratory where Tietjen spent several days digitally enhancing the area of the photos that included the car. By breaking that particular segment into a series of tiny light and dark picture elements, Tietjen was able to sharpen the characteristics of the car so greatly that a General Motors Company engineer later identified the car in both the original and recreated photographs as most likely being the same automobile. With that enhanced imagery, the police and district attorney had enough substantive evidence to arrest Auker, who was later found guilty of both kidnapping and murder charges and sentenced to death. It was the first time the digital enhancement of photographic images had been used in a criminal prosecution.

In a letter to Casey after the verdict, Sacavage wrote, "This matter will undoubtedly have far-reaching effects for the law enforcement community throughout the United States. I am certain that the digital imaging process will be developed into a useful forensic scientific technique."

And that, according to Casey "gives us tremendous satisfaction—to see justice done and to be able to put NASA technology to work in our field." •

Astronaut Don Thomas spends his weekends helping children from broken homes to emerge from the shadows. "I'm there to listen and to expose them to a different way of life," he says.

A Friend in High Places

by Sonja Alexander, Hq.

At the age of 37, Don Thomas is a success by almost any standard. A PhD. in materials science, he became an astronaut candidate in 1990, and now works at the Johnson Space Center in the Astronaut Office's Safety and Operations Development Branch. But even though you might say he's already "arrived," Thomas hasn't forgotten what it's like to be young, alone, and struggling to make a place for yourself in the world. So he reaches out to lend a hand.

For the past three years, Thomas has worked with the United Way's "Friends of Students" program, which matches adult volunteers with students from the Clear Creek Independent School District in Houston. Many of the students, who range in age from 10 to 17, are from broken homes or are children of alcoholics. Some have been abused. All of them could use a friend.

Thomas typically gets to know a particular student over an extended time, so that a pattern of trust and bonding is established. "Our time together is one-on-one; we go to dinner and usually take in a movie." An astronaut's life is a hectic one, so most of the get-togethers come at the end of the work week. But if his schedule includes traveling on the weekend, Thomas spends time with the student during the week.

Thomas's own parents divorced when he was ten years old, so he can relate to some of the problems the students are facing. "Growing up in a single-parent household can be pretty rough sometimes. I didn't see my father for over twenty years, and that can really affect you," he says.

It takes a while for the students to open up enough to talk about their problems, he says. "I'm there to listen and to expose them to a different way of life." Thomas hopes that his obvious interest in science and technology and his commitment to the space program will rub off on the teenagers, even if they do sometimes get blasé about the idea of hanging out with an astronaut.

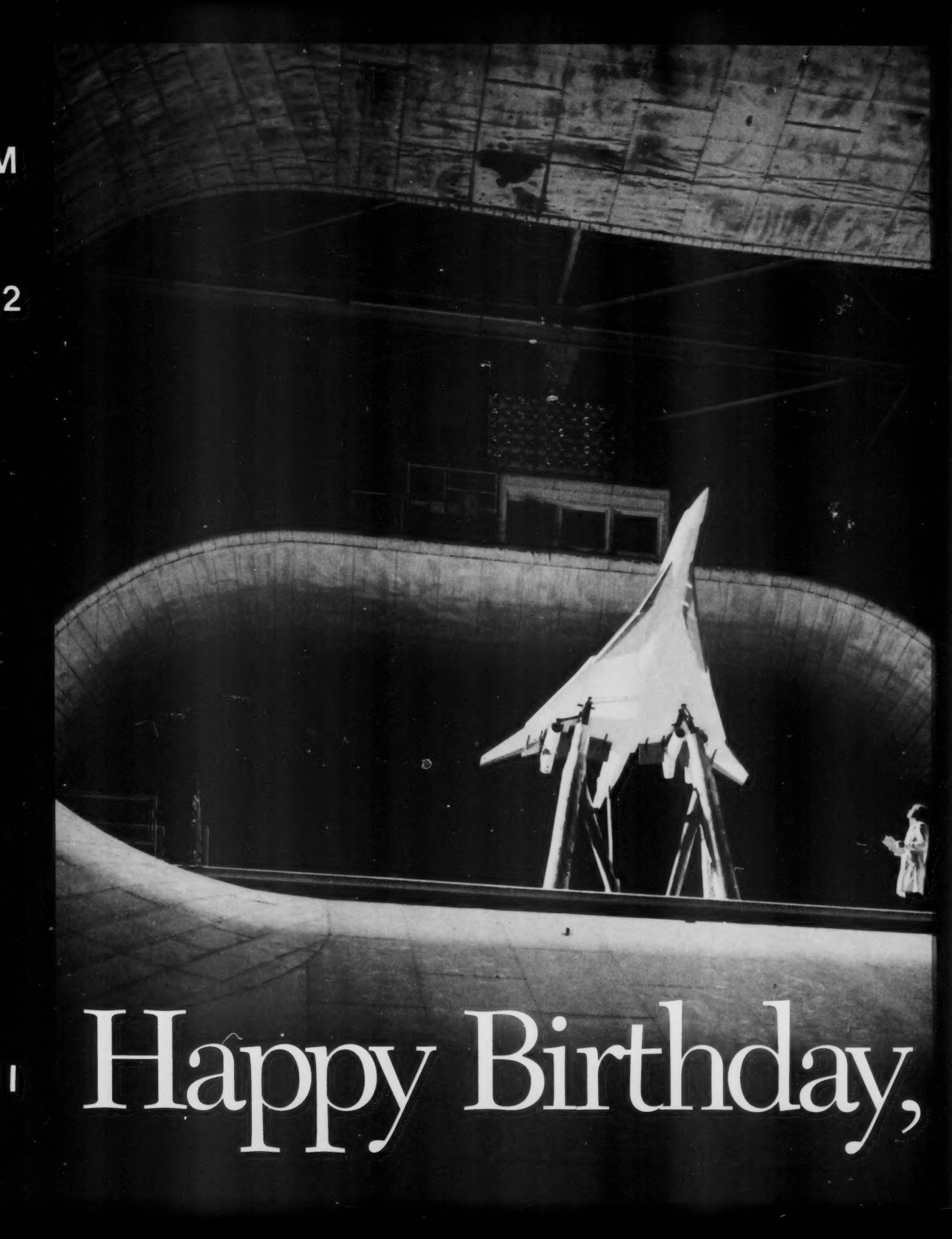
"It impresses their families more than it does the students," he says. "Their idols are usually rock stars, movie stars, and athletes."

Thomas sees his role as being a sounding board and a positive example. He points out to his students that none of his own achievements happened overnight, and that he, too, encountered failures along the way. Many kids from troubled homes have built a solid wall around themselves, he says. Some are shy and withdrawn, and some are just plain afraid.

He recalls the time he arranged to take a ride with a student on a Goodyear blimp. "The captain asked him if he wanted to steer the blimp. Being somewhat shy, he said, 'No, I'll just sit here and ride.' I asked him how many people ever got to ride in a Goodyear blimp, let alone steer one, and encouraged him to give it a try. Reluctantly he did, and the smile on his face could have lit up the world. That was so satisfying to me. These students need encouragement, or they will always be in the shadows."

Thomas admits that he rarely gets a thank you, but says he's not doing it to get positive strokes. "I'm doing it because I know it's the right thing to do."

He set his own sights on becoming an astronaut when he was six years old, and his advice to students of all ages is to find a goal, work hard to accomplish it, and don't let failure defeat you. "Anyone can achieve great things in life if they don't lose sight of their dream," he says. •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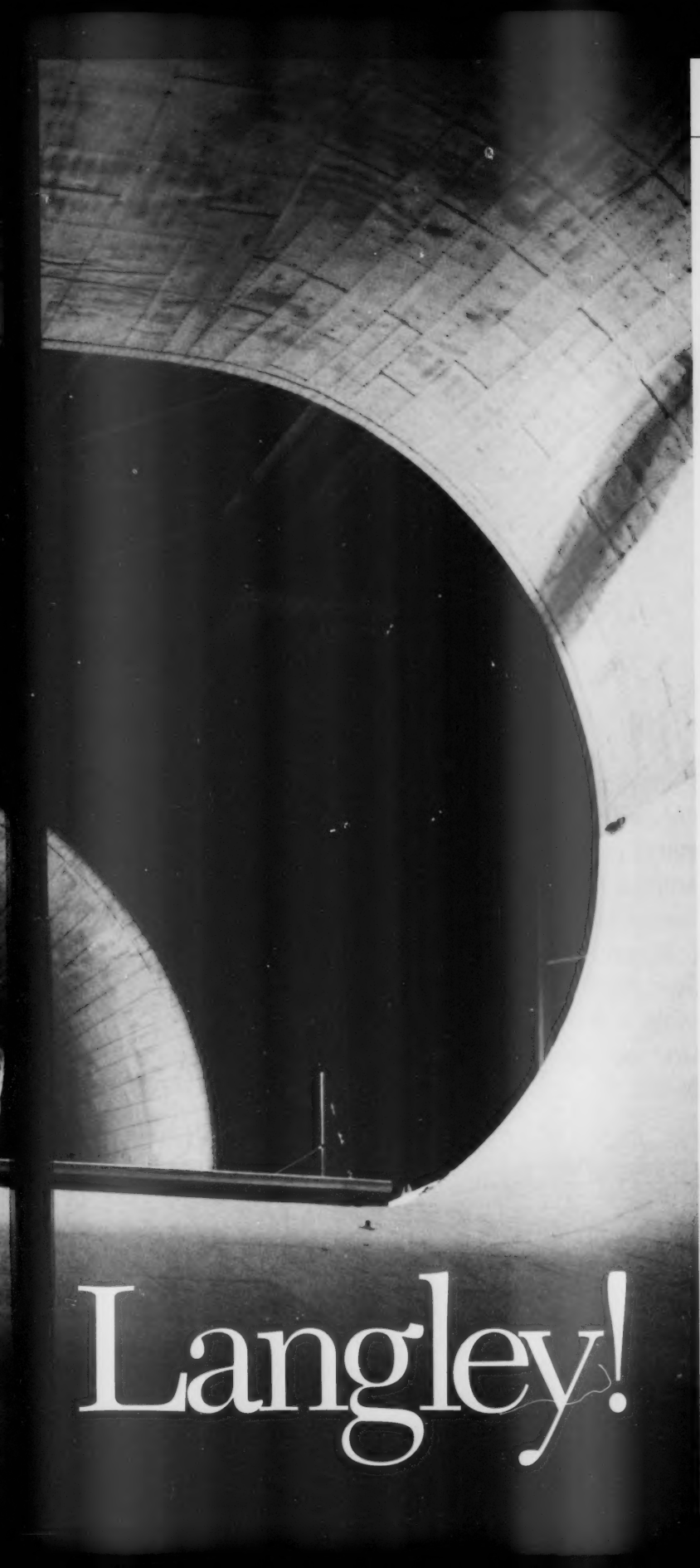


Langley!

NASA's eldest celebrates its 75th anniversary

by James Schultz

Few anecdotes from the history of flight research are as unusual as the one told about German-born aerodynamicist Max Munk.

Already a respected figure in the National Advisory Committee for Aeronautics (NACA) by the time he came to work at what was then called the Langley Aeronautical Laboratory in 1926, Munk had an autocratic, brook-no-dissent management style. It didn't take long for him to alienate a talented staff, resulting in his abrupt departure after only a year. Officially, Munk is remembered at Langley for his brilliance as a theorist; unofficially, for a stubborn highhandedness that clashed with the center's collegial, egalitarian culture.

As the story goes, Munk decided while at Langley that he wanted to learn how to drive. Ignoring the able instruction offered by a wind tunnel technician on his staff, he vowed to go it alone. He drew up a map of the road between his home in Hampton, Virginia and the Langley complex, calculating the exact distance between the road's various curves and the precise amount the car would need to turn at each of those curves. Munk then hung a string from the top of the steering wheel and applied

A model of a supersonic transport plane is tested in Langley's 30 × 60 ft. wind tunnel which has been operational since 1931.

numbered pieces of tape to indicate the degree of manipulation required to negotiate each turn. By driving at a predetermined speed, and with the help of a stopwatch and the aforementioned map, he successfully and safely navigated his way to and from the office.

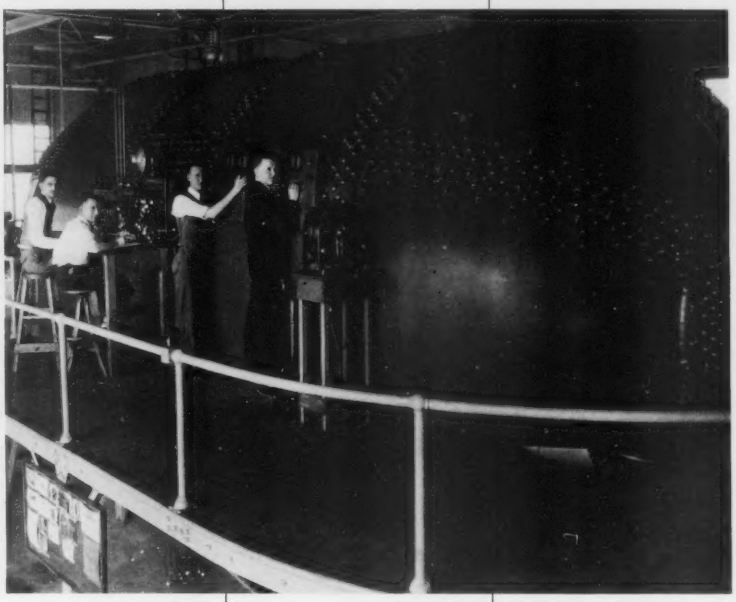
In his book, *Engineer In Charge: A History of the Langley Aeronautical Laboratory 1917-1958*, historian James Hansen calls this story "a sort of local legend, an extravagantly exaggerated one."

But there's also truth in it, he says.

"The key thing is that the folks at Langley tell such stories themselves," explains Hansen. "It's the flip side of the same coin. On one hand, the Munk story appears to be a critical one about someone losing it and going too far. But at the same time, the storytellers take pleasure in the telling: It's a mark of distinction to be that ingeniously different from everybody else."

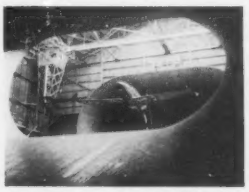
Self-sufficient ingenuity has always been one of the Langley Research Center's great virtues. As the eldest offspring of NACA and the nation's first federally funded civilian aeronautical research facility, the center began its life making do with limited resources. But make do Langley did, sometimes in spectacular fashion.

The laboratory was responsible for developing a number of the basic devices and procedures that made the modern airplane possible. Later, as a NASA research center, it led the way in developing America's manned space program. On July 17, the men and women of Langley celebrated 75 years of preeminent achievement in the technology of flight.



The variable-density tunnel team in 1929.

Paul Holloway: "At Langley there still is a can-do attitude. Over the years the arguments haven't been over if we could do it; they were over how to do it."



P-51 Mustang in the full-scale tunnel, 1943.

"We've done almost any mission one can think of, from aeronautics to astronautics," says Paul F. Holloway, the current center director. "And we've done it as active partners with industry. One of Langley's major achievements was the establishment of an infrastructure for what came to be known as the aerospace community. That's probably our greatest legacy."

The Young and the Restless

If there was one thing that characterized the laboratory in the early years, it was the youthful enthusiasm of its staff. Most of the young men who came to work at Langley (until World War II, virtually all the research engineers were male) were from northern or midwestern states. Of those, many had grown up in or near large urban areas. To local farmers and fisherfolk, clannish and distrustful of outsiders, Langley seemed less a government facility than a Yankee enclave—and a suspiciously exuberant one at that.

But as time passed, familiarity bred contentment: The locals grew fond of the young engineers who rented rooms in nearby boardinghouses, organized social and athletic functions, and courted young ladies from the surrounding area.

Relatively little was known about airplane flight in the 1920s, so the Langley engineers set out to learn as much as possible. Because aerodynamic theory sometimes lagged behind practical application, the learning was often in the doing.

"Hired fresh out of school with a minimum knowledge of aerodynamics and little

Suspended from the ceiling of a hangar, this 100-foot-diameter Echo satellite was test-inflated with forty thousand pounds of air while on Earth; in orbit, it only required a few pounds of gas to keep it inflated.

practical experience of any kind, the majority of these early Langley researchers learned nearly everything on the job," writes Hansen. "Because they were so young, they had not learned that a lot of things could not be done, so they went ahead and did them."

What the government engineers did, in close cooperation with the emerging aircraft industry, was essentially to reinvent the airplane. In 1928 Langley devised the nation's first streamlined engine cowling, a heralded advance that boosted aircraft speeds 16 percent simply by reducing drag. By the 1930s an aeronautics design revolution was well underway: The awkward, wire-braced, fabric-covered wooden flying machines of previous decades yielded to sleek metal craft that were faster and stronger. Planes like the DC-3 became the first of a new generation of aircraft that incorporated technology based on NACA's state-of-the-art aeronautical research.

Along with improved airplanes came efforts to design and build better wind tunnels and related research tools and labs. Starting with the Variable Density Tunnel in 1922, Langley's wind tunnel complex grew ever more sophisticated. One of the most notable achievements was the development by the late 1940s of a slotted-throat tunnel, which eliminated the "choking" problems that had so bedeviled researchers attempting to unravel the mysteries of the transonic flight regime. Improvements accelerated in succeeding decades. By the mid-1980s, the center's National Transonic Facility was up and running, and by the early '90s the 8-foot high temperature tunnel was being readied to accommodate large-scale hydrogen-fueled scramjet engine testing.

For several generations of motivated engineers, there were few better places to work than Langley. A position at the NACA laboratory in Hampton wasn't a mere job. For many it was a way of life. Even at lunch, equations would be scribbled, erased and rescribbled on marble countertops. Langley was the kind of place an impassioned aeronautical researcher could call home.

"No one else in the country was doing this kind of work," says Axel T. Mattson, who arrived at Langley in 1941 and retired in 1974. "Here you were, young, pink-cheeked and just out of school. We took [on-site] courses taught by the world's leading experts. It was so exciting it was unbelievable."

The Little Joe launch vehicle being prepared for a test launch from Wallops Island in 1960.

Into Space

World War II brought changes to Langley, as basic research took a back seat to more pressing projects—namely, improving the prototypes of U.S. Army and Navy aircraft. Because of wartime expansion, staff levels at the laboratory ballooned from 524 in 1939 to 3,220 by 1945.

Women also came to the center in unprecedented numbers, and one entire job category—"computers," or people who produced slide rule calculations and plotted data curves—became an exclusively female domain. This was not lost upon some of the laboratory's most dedicated male engineers, who quite literally married their computers.

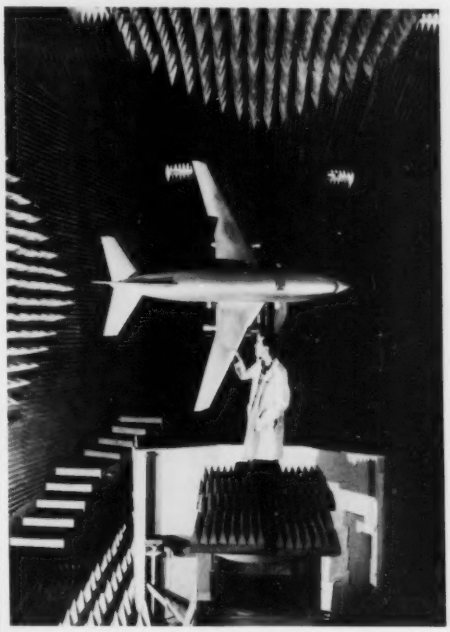
By 1940, two NACA "daughter" centers had been established— Ames in California and Lewis in Ohio—and some of Langley's most accomplished personnel went west to staff these new facilities. Meanwhile, by

Not long after this photo was taken in front of Langley's Lunar Research Facility, astronaut Neil Armstrong became the first human to step upon the surface of the Moon.

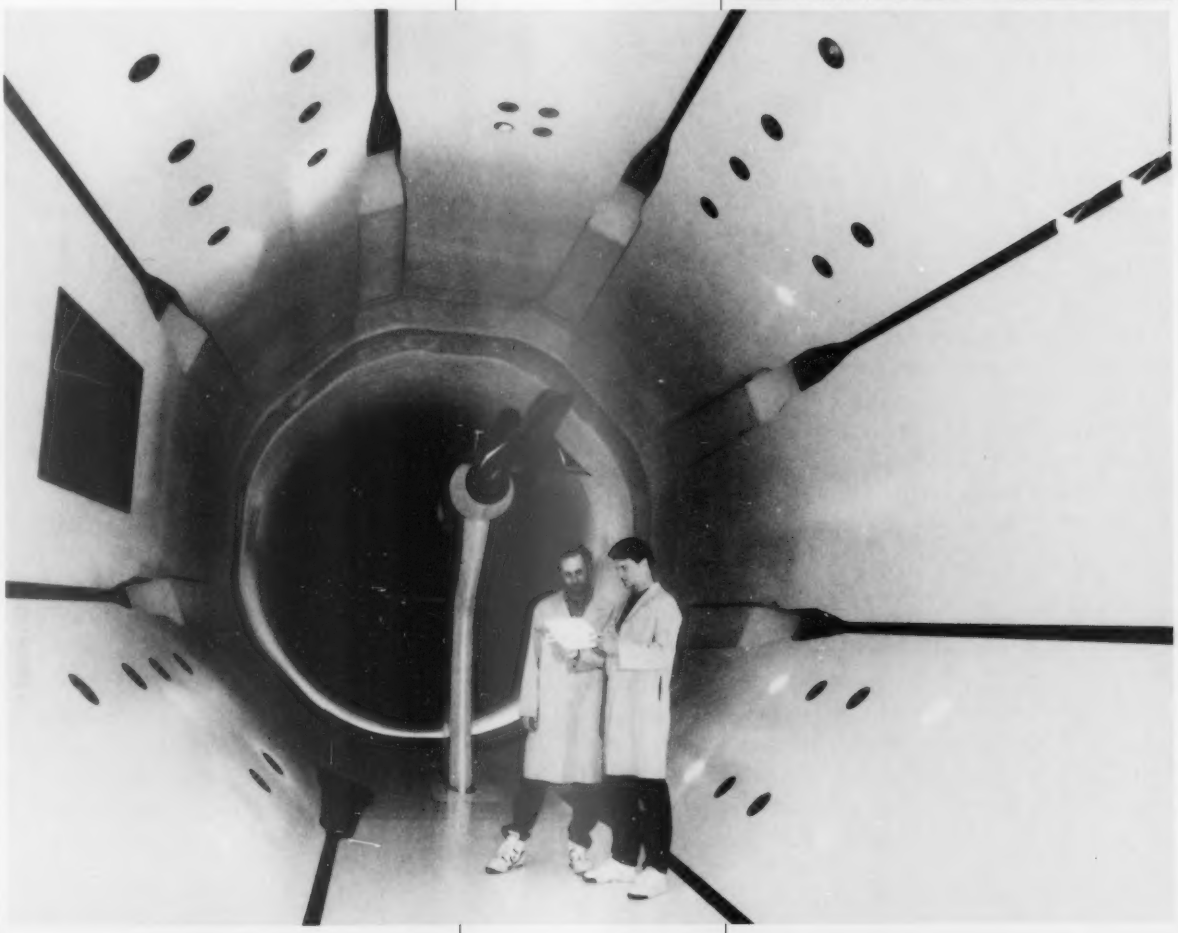
war's end the center was turning its research energies toward the problem of breaking the so-called sound barrier. Langley researchers and test pilots played a major role in the effort that resulted in Captain Charles E. "Chuck" Yeager's historic supersonic flight on October 14, 1947.

During the war, Langley also had begun rocket research at Wallops Island, on Virginia's secluded Eastern Shore. Throughout the 1940s, researchers at Wallops worked with sounding rockets in an attempt to understand and analyze transonic and supersonic aerodynamic forces. By the time the Soviet satellite Sputnik broadcast its first orbital beeps to an astonished world in 1957, Langley's rocketeers already were prepared to pick up the gauntlet thrown down by the USSR.

Axel Mattson: "Here you were, young, pink-cheeked and just out of school. We took courses taught by the world's leading experts. It was so exciting it was unbelievable."



A model of a Boeing 737 is used to collect data in the Low Frequency Antenna Test Facility.



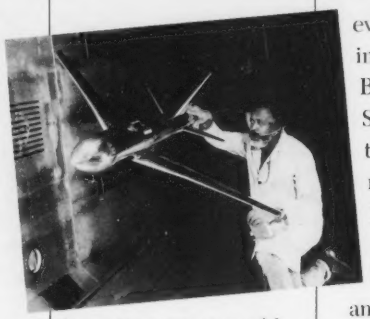
Two technicians review the test schedule for a model in the 16-ft. transonic wind tunnel.

With the space race now underway, aeronautical engineers had a new frontier to challenge them. By the end of 1958, NACA had ceased to exist, replaced by the successor agency known as NASA. So it was that Langley became a Research Center and the de facto leader of the U.S. manned space program.

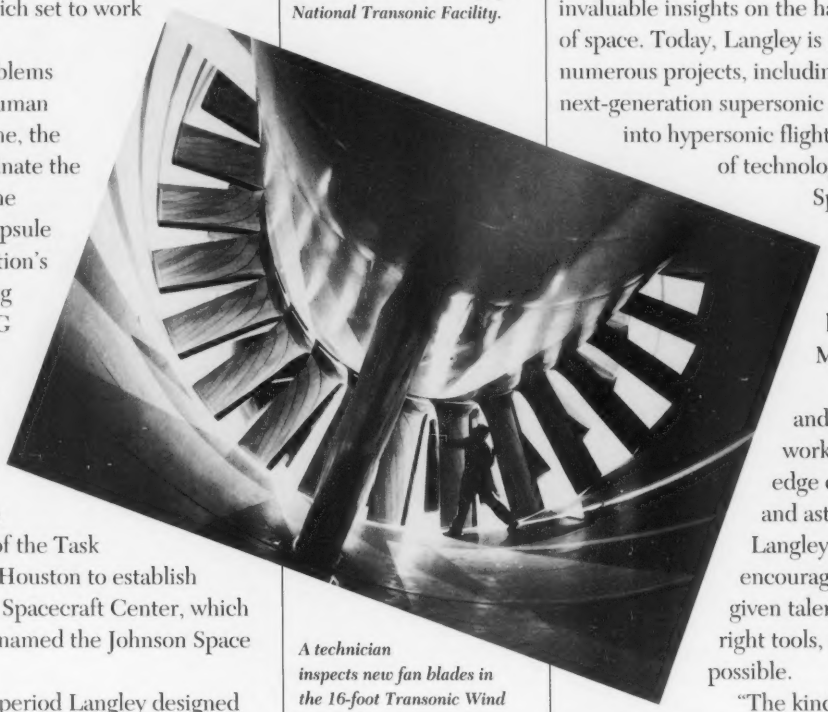
A group of veteran center researchers was organized into the Space Task Group (STG), which set to work to define and solve the problems associated with human spaceflight. In time, the group would originate the first designs for the Mercury space capsule and set up the nation's first space tracking network. The STG also organized a training program in Hampton for America's original seven astronauts. In the mid-1960s most of the Task Group moved to Houston to establish the new Manned Spacecraft Center, which eventually was renamed the Johnson Space Center.

In that same period Langley designed and managed the Lunar Orbiter Project, a highly successful program that mapped 99 percent of the Moon's surface in preparation for the manned lunar landings. The center also built simulators used by Gemini and Apollo astronauts to practice the spacecraft maneuvers that were critical to their missions.

The post-Apollo years didn't hit Langley as hard as it did some other NASA facilities. In the 1970s the center was given lead responsibility for the Viking Project, which culminated in two remarkably successful missions to the planet Mars. Langley researchers also spent much wind-tunnel time evaluating Space Shuttle designs, resulting in significant design improvements. By the 1980s, the center's Atmospheric Sciences Division was receiving international recognition for its innovative research, while on the space side, Langley scientists saw one of their prized creations, the Long Duration Exposure Facility (LDEF), launched and retrieved from orbit by the Space Shuttle. LDEF data continue to yield invaluable insights on the harsh environment of space. Today, Langley is hard at work on numerous projects, including studies of a next-generation supersonic aircraft, research into hypersonic flight and evaluation of technologies for the Space Exploration Initiative, a long-term program to send humans to the Moon and Mars.



Inspecting a transport model between test runs in Langley's National Transonic Facility.



A technician inspects new fan blades in the 16-foot Transonic Wind Tunnel.

After seven-and-a-half decades working at the leading edge of aeronautics and astronautics, the Langley culture still encourages the belief that, given talent, time and the right tools, anything is possible.

"The kinds of projects Langley has gone after have involved firsts like the Lunar Orbiter and Viking. That kind of success was unprecedented," says center director Holloway. "At Langley there still is a can-do attitude. Over the years the arguments haven't been over if we could do it; they were over how to do it."

The next NASA center may well be established in orbit, perhaps even on the Moon. But no matter what NASA's ultimate destination, it seems certain that Langley will continue to do what it has always done: figure out what works, then what works even better. •

Photos courtesy of the LaRC

James Schultz is a freelance writer who specializes in science and technology writing. He is the author of Winds of Change, *a 75th anniversary history of Langley, which is his third book. He also has written a contemporary history of Richmond, Virginia and a history of the rise to prominence of a southwest Virginia coal company.*

The People Factory

Although Langley's many milestones in basic and applied astronautical research are likely to take center stage during this year's 75th birthday celebration, the center's most significant contribution to astronautics has little to do with machines or inventions.

"We talk an awful lot about technical accomplishments, and Langley certainly has had—and continues to have—its fair share of those," says center director Paul F. Holloway. "But Langley played a major role in another area that doesn't receive as much attention. It provided many of the leaders, both in industry and government, who went on to create this country's aeronautic and aerospace infrastructure."

Holloway points out that all of the early senior staff at other NACA centers came from Langley, and that people from Langley played a major role in getting the early space program going. "In my opinion," he says, "our biggest resource has always been a terrific group of people."

Many Langley "graduates" have gone on to distinguished careers in both the private and public sectors. Fred Weick, for example, led the Langley team that developed the nation's first streamlined engine cowling, and proposed the incorporation of the tricycle landing gear onto commercial aircraft. The "swept-wing" theories of Robert T. Jones proved invaluable to designers working on later-generation sub- and supersonic aircraft, while another Langley veteran, Richard T. Whitcomb, originated the Area Rule, a new concept in the shaping of high-speed aircraft, and invented the so-called supercritical (referring to any speed beyond the critical Mach number) airfoil to delay the drag rise that accompanies transonic airflows. Now retired, Whitcomb still lives in Hampton.

Langley researchers also made important contributions in the concerted national effort to get Americans into space. H. Julian "Harvey" Allen, who worked at the center through the late 1930s, eventually became chief of high-speed research at NACA Ames, where he devised a heat-dissipating blunt-body shape later incorporated into the design of space capsules.

Perhaps Langley's biggest contribution to the human conquest of space, however, was the 36-person Space Task Group (STG). Led by Robert R. Gilruth, the group included such pioneers as Maxime A. Faget, Caldwell C. Johnson and Christopher C. Kraft, Jr.. Although it later moved to Houston, the STG was the nucleus around which the entire U.S. manned space program condensed.

And it all began at Langley. •

A group from the U.S. Army Corps of Engineers surveys the future site of Langley Field in the fall of 1916, after considering 15 sites throughout Virginia and six other states.

For its 75th birthday the Langley Research Center commissioned a condensed history entitled *Winds of Change: Expanding the Frontiers of Flight*. This 140-page, coffee-table book contains numerous photos along with text that incorporates the comments of many past and present Langley employees. *Winds of Change* will be made available to the general public in July at the conclusion of Langley's anniversary observances. —*Editor*

It's a rocket! It's a plane! No, actually it's a souped-up NASA hot rod.

Heavy

by Les Dorr, Jr.

Think of NASA's great endeavors. Think of the stunning views of far-off planets, of Shuttle orbiters drifting over a clouddappled Earth. Think of exotic "X-planes" zooming over the California desert.

Think of the Little Old Lady From Pasadena.

The rock-and-roll epitome of lead-footed, triple-carbed, four-wheeled speed would feel right at home with NASA. Over the years, specially modified automobiles have done important space and aeronautics research for the agency. We're talking genuine, all-American heavy metal, some of the best and fastest that Detroit had to offer.

Back in 1962, NASA's Flight Research Center (today's Dryden Flight Research Facility) was preparing to test a new type of aerospace vehicle called the M2-F1 "lifting body." The piloted glider lacked wings. Instead, the underbody would create lift, a design that gave the tubby craft its name.

Wind tunnel tests predicted the shape should fly well, but center director Paul Bikle wouldn't let the M2 be hauled aloft by a tow plane until its handling qualities were better understood. He and lifting body pioneer Dale Reed brainstormed an alternative: Why not have a car pull the craft fast enough to get it airborne at low altitude, where it could be checked out with little risk?

Bikle tapped engineer Walt Whiteside, a self-described "fixit, go-get-it type," to find a suitable high-performance automobile. Whiteside got out his slide rule

Metal

and figured the speed and horsepower he would need, then called around to see what was available. He settled on a souped-up Pontiac Catalina convertible that was a real hot rod, even for those days when zero-to-60 performance was everything and the concept of good gas mileage was still years in the future.

"General Motors gave us a 421-cubic-inch, triple-carburetor engine like those on the Pontiacs running at the Daytona 500, a four-speed transmission and heavy-duty suspension and cooling systems," Whiteside recalls. "They also agreed to do it with no publicity. We were doing this kind of under the table, without talking to NASA Headquarters."

The center engineers took the "stock" Pontiac to a pair of high-performance auto shops, where it was fitted with a rearfacing seat, roll bar and special headers, then tuned for maximum horsepower. When the work was complete, Whiteside and NASA pilot Don Mallick did what they would do with any new research vehicle: They took it out on a series of check flights.

"We grabbed our clipboards and strapped on our helmets, then headed toward Boron (California) and Highway 395. Up that way there were plenty of 'measured miles' that we could use to calibrate the speedometer up to its maximum of 120 mph," says Whiteside. "That was also where we knew we'd find the fewest Highway Patrolmen."

After its break-in period, the Pontiac was ready for action. Whiteside remembers "nothing special" about towing the M2-F1

NASA's original "hot rod," this stripped-down 1962 Pontiac Catalina convertible was used as a tow vehicle for the M2-F1 lifting body–ancestor of today's Space Shuttle–at NASA's Flight Research Center (now Ames-Dryden Flight Research Facility).

into the air at 114 mph for the first time on April 5, 1963. No jokes, no unnecessary talk. NASA pilot Milt Thompson matter-of-factly called out his altitude, while Whiteside radioed the Pontiac's ground speed. The success of the first flight led to a routine test program; during the next four months, the M2 sailed behind the car on 100-plus flights (including a checkout hop for famed Air Force test pilot Chuck Yeager), with a total logged time of about four hours.

The white-and-yellow Catalina remained a familiar sight on the desert lakebed as it towed a variety of other piloted and unpiloted vehicles into the air, chalking up a total of 490 test runs. During the X-15 program, Whiteside often roared up and down the North Lake area in the car to make sure there were no obstacles to a safe landing by the rocket plane. He also acted as "photo chase" for NASA's B-52 mother ship, pacing the aircraft on its takeoff roll while a photographer snapped pictures from the "cockpit" of the Pontiac.

"The first time we took off, I wound up to around 130 mph," says Whiteside. "Then I looked back and the NASA photographer, Gene Childress, was just about plastered against the trunk! We never considered that he might need a safety harness to take the wind strain off him."

"We grabbed our clipboards and strapped on our helmets, then headed toward Boron and Highway 395....That was where we knew we'd find the fewest Highway Patrolmen."

By the late 1960s the Pontiac was tired out and headed for the "surplus" graveyard. But then it received one last call to NASA duty—this time, 3000 miles east.

Langley Research Center's Walt Horne was a zealot for pavement grooving—cutting thin slots in runway and highway surfaces to improve traction. To prove the concept, he did many high-speed automobile braking tests in the mid-1960s on a variety of wet and dry surfaces—grooved and ungrooved—at Wallops Flight Facility on the Virginia coast.

Horne and NASA researcher Tad Leland also had come up with a way to keep the test autos from spinning out on wet pavement. By installing brake line cutoff valves, they could brake only the wheels diagonally opposite from each other while the other two wheels rolled free. The result: A car that could maintain a straight line while taking data on tire friction.

Horne had used a diagonally-braked Ford Fairlane to study loss of tire friction ("hydroplaning") on wet surfaces. Later, he modified a Plymouth Fury station wagon from

NASA used a 1967 Plymouth Fury station wagon in pavement grooving and traction studies at Wallops Flight Facility.

the NASA motor pool with a similar setup. But the Plymouth's weight and plain vanilla engine made it a dog in the acceleration department, and it had already racked up high mileage before its conversion.

In 1968, Horne had the Flight Research Center's hot rod Catalina shipped to Langley, where he fitted it with diagonal braking. At Wallops, he did spinouts on a special "skid pad" to check the friction of several tire tread patterns on various surfaces at the request of the Virginia Highway Research Council. The test speeds were relatively sedate for the Pontiac—a maximum of 50 mph—although Horne admits that he once got the car up to "about 110" on the long Wallops runway.

The Pontiac's power and acceleration convinced Horne and Langley engineer Tom Yager that they should get a new, more dependable high-performance car for "Combat Traction," a joint NASA/Air Force braking study on 50 U.S. and European runways. Their choice was a natural "muscle car": a 429-cubic-inch 1969 Ford XL coupe.

Besides adding a roll bar for safety, Horne and Yager left the Ford pretty much alone. They did add an anti-skid braking system to the front wheels—the top-of-the-line Ford already had it on the rear—because planes normally had such equipment. Horne soon found that early automotive anti-lock brake technology wasn't quite up to the job, however.

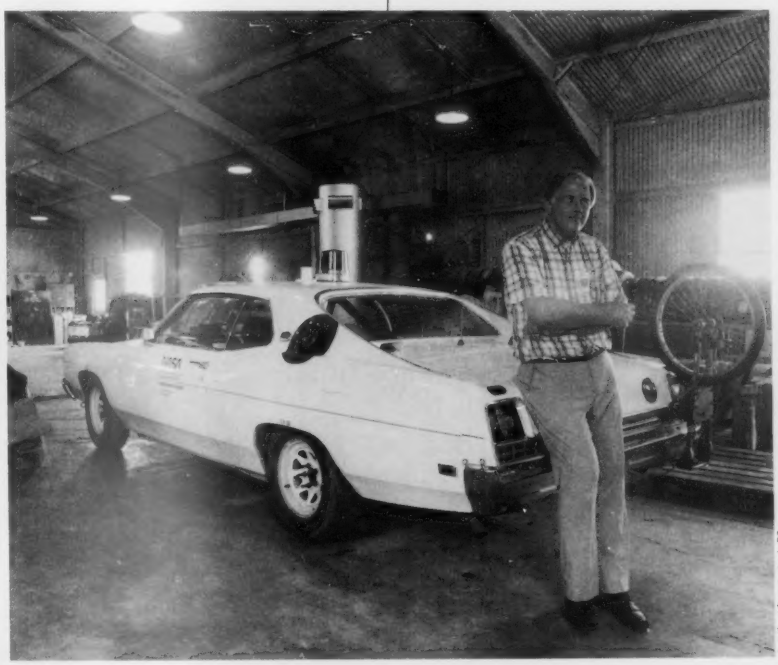
"I tried the system out at Wallops before we went to Europe," Horne remembers. "It worked in stops from 20, 30, up to 60 mph. But at 70, the rear wheels locked up and the car swung around. I ended up rolling backward down the runway at high speed. I finally had to slow down by putting on the gas!"

"That was the end of the anti-lock system," adds Horne. "We went back to diagonal braking."

The 1968-69 Combat Traction tests were only the start of the Ford's NASA career. Thousands of times over the next 23 years, the car did braking runs on runways around the world. Yager recounts a standard test procedure that sounds like those performed by NASA research pilots:

"I'd turn on the recorder and make sure the seat belts and shoulder harness were fastened. Then I'd mash down the accelerator and get up to 65 mph. A couple hundred feet before the test section, I'd throw the car into neutral, then aggressively apply the brakes as I entered it. When I came to a stop, I manually recorded the stopping distance off a meter on the dash and flipped the recorder off."

The point of using a diagonally-braked car in the NASA tests was to develop a way to forecast aircraft braking performance under various weather conditions. For the first several years, the Langley researchers painstakingly analyzed "friction-speed curves" developed from data



photo/Carol Petrachenko, LaRC

Above, a 1969 Ford XL is used as a noise source for instrument calibration; right, Langley engineer Tom Yager with the Ford which still serves NASA at Langley.

taken by the Ford and several specially instrumented planes. By 1973, says Horne, they felt they "had a good handle" on being able to predict how well aircraft could stop on dry, wet and snow-covered runways.

During the 1970s, the Ford XL took friction readings at airports and Air Force bases where officials suspected rubber contamination from aircraft tires was building up, or where skidding accidents had occurred on wet runways. In 1978, Yager and the car headed west to support a National Transportation Safety Board accident investigation. A DC-10 airliner had blown a tire on takeoff and crashed into the runway approach lights at Los Angeles International Airport.

"We got measurements on the runway and were able to relate them back to the actual black box [flight recorder] data from the DC-10. The readings from the plane agreed with the tire friction performance predicted by the diagonally-braked vehicle," says Yager. "Since then we've looked at about 20 more wet runway skidding accidents using that technique."

When the Space Shuttle was ready to start landing tests in 1977, NASA called on the Ford to pave the way. The car made hundreds of test runs across the dry lakebed near Dryden to identify any soft spots and find out how much traction the surface would provide. Later, the car took friction readings on the gypsum runways at White Sands Space Harbor in New Mexico and on the 15,000-foot concrete runway at Kennedy Space Center in Florida—information eventually used to formulate some of the Shuttle's landing rules.

Langley's Ford still soldiers on doing NASA research. In May, for example, the car returned to Wallops for tests of a Czech friction unit marketed by a California company. Future tasks include studies of how anti-snow and ice chemicals affect runway friction, as well as tests to help define the effect of natural rainfall on traction.

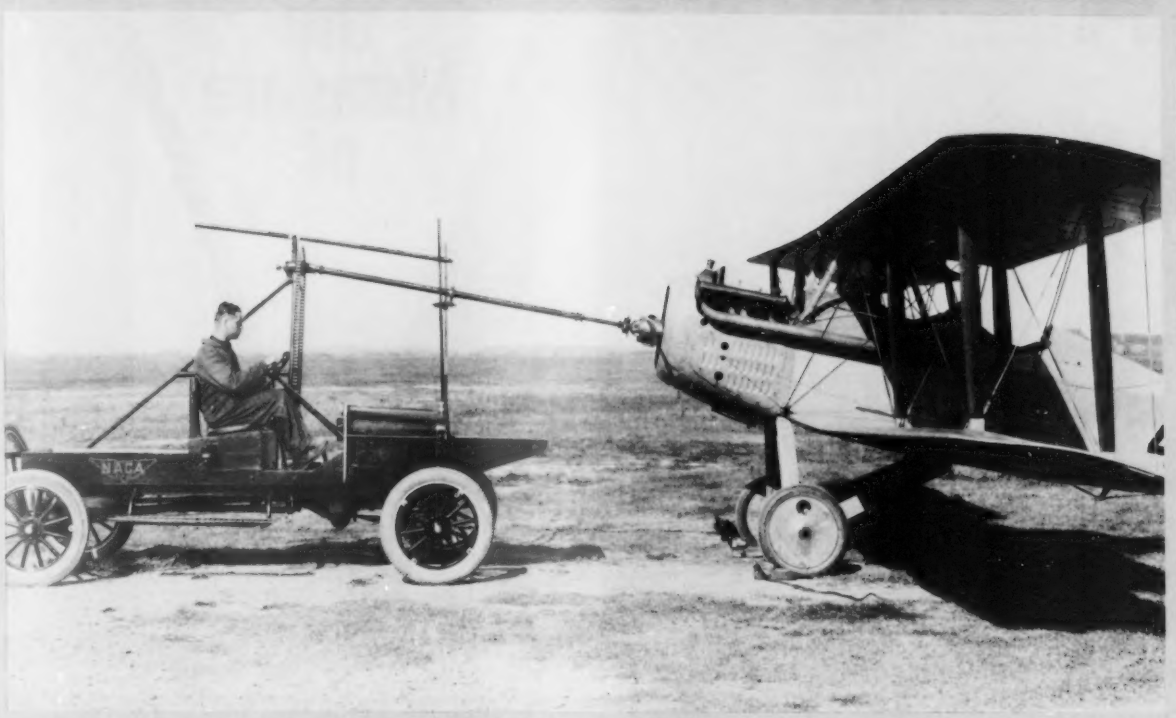
Even with only 46,000 miles on its odometer ("Probably the least for any 1969 Ford in the country," Yager chuckles), the Ford's time may be running out. Advances in aircraft computers and electronics make it possible to write programs that can display braking performance for pilots in real time, eliminating the need to estimate it with a ground vehicle. But Tom Yager isn't ready to trade his gas pedal for a computer screen just yet.

"Knowing the things we've gone through over the years just to get people to recognize the reasons to monitor runway friction," he says, "I suspect that's going to be easier said than done." •

Les Dorr last wrote for the magazine about high-speed aircraft research.

Today, the Ford XL "muscle car" is still part of Langley's runway friction research program.

The Detroit Connection



A modified Ford Model A used to start aircraft propellers, circa 1931.

When NASA's SR-71 "Blackbirds" get ready to fly at Dryden, a deafening roar booms across the concrete runway apron—not from the jets themselves, but from two 454-cubic-inch Chevy V-8s in the "starter cart" that ground crews use to crank up the planes' engines.

The SR-71 ground equipment is just the latest way that NASA and its predecessor, the National Advisory Committee for Aeronautics (NACA) have put off-the-shelf automotive technology to work in aeronautics and space research programs. Some other examples:

A modified Ford Model A truck served as an aircraft starter in the early days of flight research at Langley. A shaft connected to a plane's propeller turned over the engine.

In the late 1930s, Langley researchers used a 1938 Chevrolet fitted with an aerodynamic fairing to haul gliders into the air. The tests produced data on the ground effects of towed gliders.

An airtight 35-foot-long Airstream travel trailer was home to several Apollo crews for the first 65 hours after they returned from the moon. The converted trailer cocooned the astronauts so that doctors could sniff out possible lunar germs.

From the mid-1970s to the late 1980s, the engine, front-wheel-drive and frame of a 1973 Oldsmobile Toronado pulled airplane models through Langley's Vortex Research Facility. The engine, beefed up with improved carburetion and racing parts, churned out about 500 horsepower.

A subscale F-15 robot research plane arrived at Dryden sans landing gear in 1972. Resourceful NASA engineers scratchbuilt the gear, including auto shock absorbers bought at the nearest Sears department store.

Before and after its 69-month stay in space, NASA's Long Duration Exposure Facility (LDEF) satellite was assembled and hauled around in a transporter made from two Fruehauf truck trailers that had been chopped apart and welded together to make a single carrier. —*Les Dorr, Jr.*

Taking the Measure of Ma

Ah, Mars, the Red Planet. Shrouded in ancient mystery, never before visited by a spacecraft, never photographed until now, never…

Wait a second. Haven't we already *done* Mars?

Well, yes. But saying we've done Mars is a little like saying you've seen Europe just because you had a three-hour layover in Brussels. So we're going back for a closer look.

This September, the U.S. will send its first mission to Mars since the Viking project of the 1970s. For one Martian year (687 Earth days) Mars Observer will orbit the planet, collecting a wealth of information on its weather systems, magnetic field, global topography, surface chemistry and mineralogy. As Project Scientist Arden Albee of the California Institute of Technology puts it, "We will not be just *exploring* Mars. Instead, we will be systematically *observing* Mars over an entire Martian year."

It's been 16 years since the two Viking orbiters and landers visited Mars, and planetary scientists have pretty much gleaned what they can from poring over the same old data again and again. "There are some things we say we 'know' from Viking," says Albee, "but we only know that from the basis of one observation."

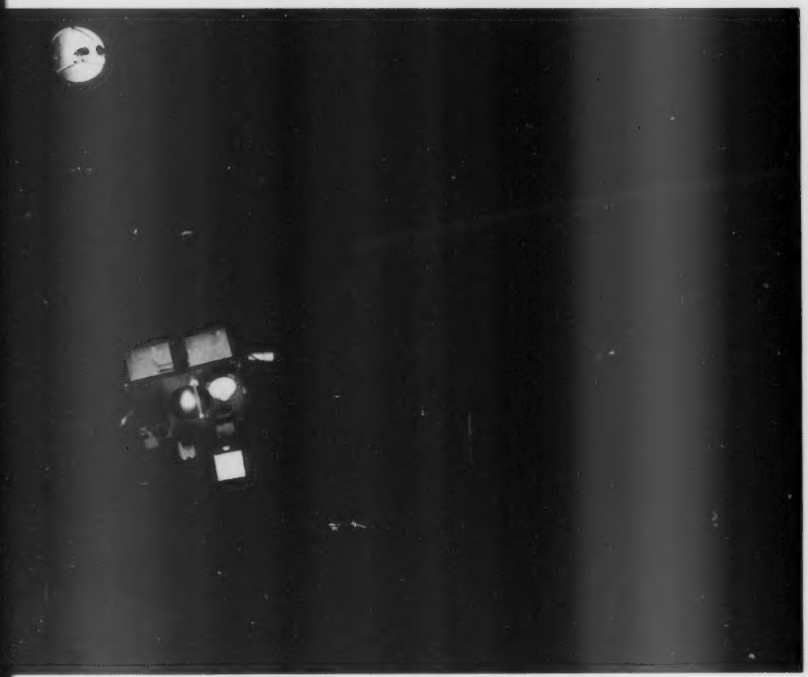
Mars Observer will have the huge advantage of continuous, long-term coverage—much as Earth-orbiting satellites keep year-round watch over our own planet. In fact, says Albee, "The approach is very much like EOS [the Earth Observing System]. We're trying to get these basic data sets—not to answer specific questions necessarily, but to be able to answer a whole host of different kinds of questions, some of which you can't even pose at the moment."

The mission, which is managed by the Jet Propulsion Laboratory, is scheduled to get underway on or about September 16 (the launch window lasts 24 days) when Mars Observer will be launched on a Titan III commercial launch vehicle from Florida. Attached to the spacecraft will be a Transfer

by Tony Reichhardt

ars

Mars Observer goes for the Big Picture



Orbit Stage (TOS) built by Orbital Sciences Corporation, which will mark the first use of this commercial upper stage.

After an 11-month cruise through interplanetary space, Mars Observer arrives at its destination in August 1993. At first its orbit around the planet will be high and elliptical. Gradually this will be adjusted to a near-circular, near-polar mapping orbit approximately 250 miles above the Martian surface. The orbit will be sun-synchronized, meaning that sunlight will be coming from the same angle throughout the mission.

Each day the spacecraft will return images from its digital cameras as well as data from its other onboard sensors (see "What's Onboard"). The philosophy of the mission, says Albee, is to have all these different instruments working in concert, building up a comprehensive portrait of a world. "It's not that any one instrument is probably going to make a discovery," he says. "What we're going to have are these synergistic data sets."

For example, scientists would like to better understand the seasonal variations in the Martian polar caps, which are made primarily of carbon dioxide. The ice caps expand in the cold of Martian winter and shrink due to melting in the summer when it's warmer. "This is a tremendous change," says Albee, "like the ice ages on Earth. The amount of material being transferred [between the surface and the atmosphere] is just incredible." By tracking that transfer of material with several different instruments, Mars Observer will in effect be watching one of the planet's "life processes" in action.

The nature of magnetism on Mars is one puzzler that this mission could help to solve. The planet's magnetic field is known to be very weak, and may not even exist at the present time. "Everything we know about the geology argues that if it isn't there now,

After being boosted out of Earth orbit by a Transfer Orbit Stage (opposite page), Mars Observer will arrive at Mars in August 1993.

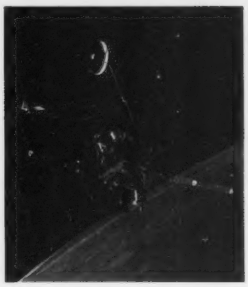
it must have been there not too long in the past," says Albee. The onboard magnetometer will search for direct evidence of an existing field, while the electron reflectometer looks for subtler historical clues: Even if there is no magnetic field today, the instrument may be able to detect remnant fields in surface rocks that were formed in the geologic past.

Another nagging question is whether there is or ever has been water on the surface of Mars. "Since Viking, our ideas on water on Mars have gone back and forth like a pendulum," says Albee. "First there was abundant evidence for it, then we said, 'Gee there isn't any water there.' And now we figure there's got to be water—it must be under the surface." Mars Observer should help clear up the mystery. While the gamma ray spectrometer searches for traces of hydrogen, high-resolution pictures from the camera may show permafrost or channel features that reveal how much water once flowed on the surface, and when.

Ironically, adding the Mars Observer camera was an afterthought to the original mission plan. As the first of the new Planetary Observer class of spacecraft, the project is designed to be modest in scope and relatively cheap. That meant that "If [the camera] had any chance of being chosen, it had to be very, very simple," says Albee.

The solution was to build a camera with no moving parts. "It doesn't have a shutter, it doesn't have movable mirrors. It's controlled basically by opening it up and taking data, and then editing the data," says Albee. The resolution of the pictures depends only on how much information is extracted from the raw images and then sent down to the ground—an editing job that will take place inside a powerful onboard processor. "The camera by itself has more computing power and more memory than all the spacecraft JPL's ever flown put together," says Albee.

During the mission the camera will return a low-resolution image of the whole planet each day, in much the same way that weather satellites do for Earth. Moderate resolution (down to about 300 meters) images will be less frequent, but will still provide global coverage many times over by the time the mission is finished.



The primary mission will last one Martian year—687 Earth days.

Mars Observer will have the huge advantage of continuous, long-term coverage—much as Earth-orbiting satellites keep year-round watch over our own planet.

The high-resolution imagery is where Mars Observer's camera will really shine. Viking and Mariner have photographed the entire surface of Mars at a resolution of 250 meters, which is about equivalent to Mars Observer's moderate resolution. But at 100 meters resolution, the earlier missions only covered about 15 percent of the planet. And at 20 meters, the coverage drops down to a paltry two-tenths of a percent. Mars Observer's narrow-angle views will beat that resolution by nearly a factor of ten, with each picture element, or pixel, representing 1.4 meters on the surface, given the spacecraft's altitude of 250 miles.

These highest resolution images will be relatively few and far between, however: Buffer space on the onboard processor won't allow more than one such picture per orbit. Targeting these highresolution photos will be no mean trick, either, given the uncertainties of orbital position and timing and the fact that the camera will not be actively controlled or pointed.

But the payoff could be enormous. Two targets of particular interest will be the Viking landing sites in Chryse and Utopia, where a pair of now-dormant robots still stand where they touched down 16 years ago in the windswept plains. The landers themselves will be only pinpoints in the images, but high-resolution pictures of the surrounding area would be fascinating to compare with photos of the landing sites taken from the ground more than a decade ago.

"From a science point of view, it's really important to get that image of the Viking lander sites because we have data from the surface," says Albee. "So we're going to work like hell to get it."

Still, the camera was designed for global, systematic mapping coverage rather than very precise pointing. Can we guarantee that we'll get a picture of the landing sites? "The

answer is no," says Albee.

Other high-resolution images are planned not for specific objects so much as selected kinds of terrain—dune fields, for example, or ancient water channels, or the layered geology around Mars' polar caps. In addition, says Albee, "You would clearly like some high-resolution images of the slope of Olympus Mons— not any one particular spot, but samples to see how to interpret it."

Late in the Mars Observer mission, from September 1993 to February 1996, the spacecraft may also get the chance to collaborate with an international "partner." If the Russian-led Mars '94 mission comes off as planned, it will carry a clever and ambitious French-designed experiment to explore the Martian surface with specially instrumented balloons. Onboard Mars Observer will be a radio relay—supplied by the French Centre Nationale d'Etudes Spatiales—that will receive signals from these instruments on the ground. The data will then be formatted by Mars Observer's powerful onboard processor for transmission to Earth.

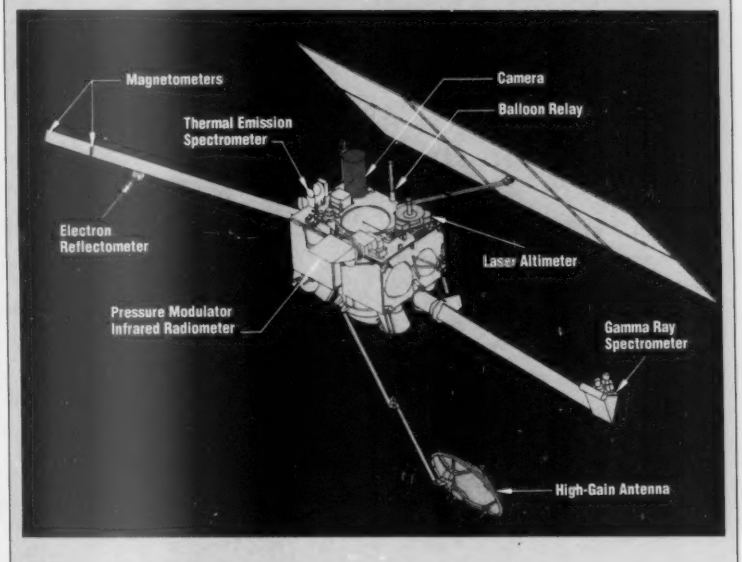
With imagery and other data from Mars Observer flooding back to Earth daily throughout the nearly two-year mission, the scientific investigators will have a very different job than they did for past planetary encounters like Voyager and Pioneer. For those fly-bys, the scientists would all gather in Pasadena during a single intense period of science return. For Mars Observer, rather than the scientists going to the data, the data will come to them. All the mission's principal investigators will be equipped with their own computer work station where they can receive data from the spacecraft and update commands to be sent to their own instrument, all without ever having to leave home. As a result, says Albee, "We have a much leaner operations group than we would ever have had in the past."

Mars Observer and Magellan represent a new generation of planetary missions where the emphasis is not so much on discovery as on close examination and deeper understanding. These missions are less dramatic, perhaps, than Voyager's and Viking's first looks, but their scientific return is much richer. Which means that by the time Mars Observer finishes its business sometime in the mid-1990s, planetary scientists won't any longer be forced to drag out their old Viking photos when you ask them what's new on Mars. •

Mars Observer: Painting a detailed portrait of a world.

Tony Reichhardt is a freelance writer based in Washington, D. C.

What's Onboard



Mars Observer will carry a total of seven science instruments:

The **Mars Observer Camera** will take digital images in high-, medium-, and low-resolution modes.

A **Gamma-Ray Spectrometer** will measure the abundance of elements on the Martian surface, including iron, silicon, uranium, and hydrogen—the latter of which could provide clues to the presence of water ice.

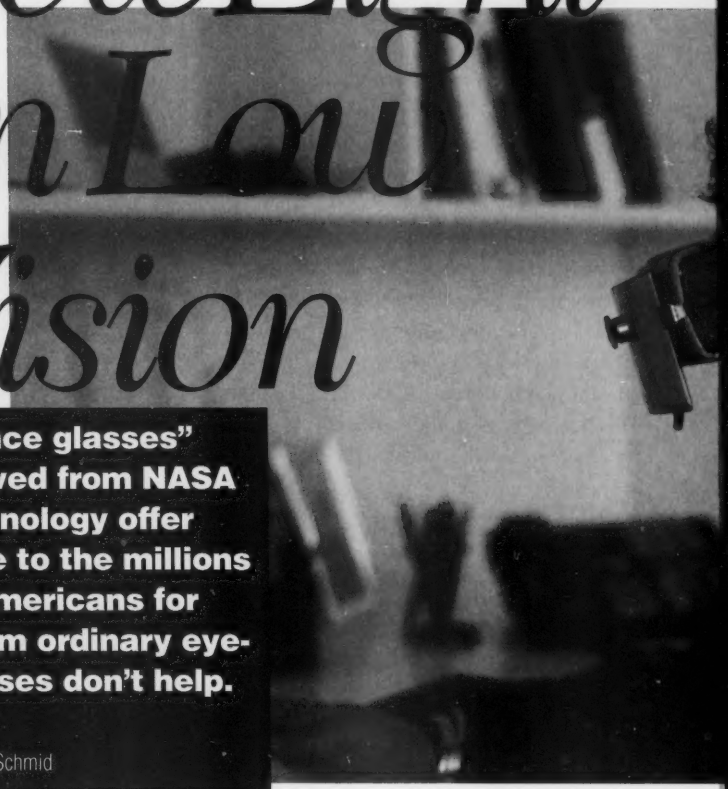
The **Thermal Emission Spectrometer** will map minerals and temperatures on the surface, as well as return information on cloud composition.

While a **Laser Altimeter** determines topographic relief, tracking data from the spacecraft's radio will measure the Martian gravity field. The radio also will be used to build up a temperature profile of the atmosphere.

The **Pressure-Modulator Infrared Radiometer** will observe the mixing of dust, ice, water vapor, and other constituents of the atmosphere at different latitudes and longitudes as it changes throughout the Martian seasons.

A **Magnetometer** and **Electron Reflectometer** will measure the magnetic field and determine how it interacts with the solar wind. •

Shedding New Light on Low Vision



"Space glasses" derived from NASA technology offer hope to the millions of Americans for whom ordinary eyeglasses don't help.

by Beth Schmid

One of the most poignant memories from 1992's Winter Olympics was the sight of ice skater Nancy Kerrigan's mother, straining to see her daughter give the performance of her life to win a medal for the United States. Quite possibly Nancy's effort to win the bronze was exceeded only by her mother's effort to witness her triumph.

Soon, thanks to a NASA/Johns Hopkins University Wilmer Eye Institute cooperative effort called the low vision project, the approximately three million Americans suffering as Mrs. Kerrigan does from low visual acuity will have high-tech help.

Scientists from the Stennis Space Center and Wilmer adapted NASA technology originally developed for computer processing of satellite images, along with head-mounted vision enhancement systems originally generated for use on Space Station Freedom, to improve the seeing of low vision patients. By enhancing and altering the TV images displayed inside specially designed goggles, this technology will enable patients with impaired eyesight to live a more normal life.

Low vision refers to chronic, disabling eye impairments that are uncorrectable with traditional glasses, contact lenses or eye surgery. About 800,000 Americans with low vision are categorized as legally blind, meaning that they have vision worse than 20/200 in the better eye, even while wearing corrective glasses or lenses. Yet more than 80 percent of those who are legally blind retain some vision.

The low vision system, which will "remap" distortions in the eye to compensate for degradation of the retina or other impairments, consists of a pair of wrap-around "space glasses" and a portable computer. Mounted in the glasses are one or more cameras, along with display screens and an eye tracker. When a patient looks at an object appearing in the video image in front of their eyes, the cameras "look" wherever the eyes look.

The cameras then send the image to a computer-based system located in a small pack worn around the waist. The computer's software, which is tailored to the patient's specific visual problem, manipulates the image and sends it back to be displayed on small video screens in front of each eye.

"Instead of looking through ground glass, you will be looking through a computer," says Doug Rickman, the NASA Low Vision Project manager at Stennis.

The prototype of the space glasses weighs 22 ounces, but the

Stennis's low vision project manager Doug Rickman models the space glasses.

weight is expected eventually to drop to about a pound. The system currently "sees" in black and white; color would require more visual data and would be much more expensive. When the space glasses become commercially available—in the fall of 1993, according to current plans—they are targeted to cost in the neighborhood of $4000.

Although that might sound prohibitive, it seems like a good deal when you consider the other aids for low vision that are now available. To date, the standard treatment for patients suffering from low vision has been to use various methods to magnify images, making them more detailed and providing more contrast.

Some low vision patients carry a whole array of magnifiers wherever they go, just to be ready for any

"Instead of looking through ground glass, you will be looking through a computer"

circumstance, according to Rickman. There are glasses with telescopic lenses for close-up work like painting or reading, and there are videoscreen print magnifiers. Closed-circuit TV—a 30-year old technology—provides one of the only ways for some patients to read or write at all.

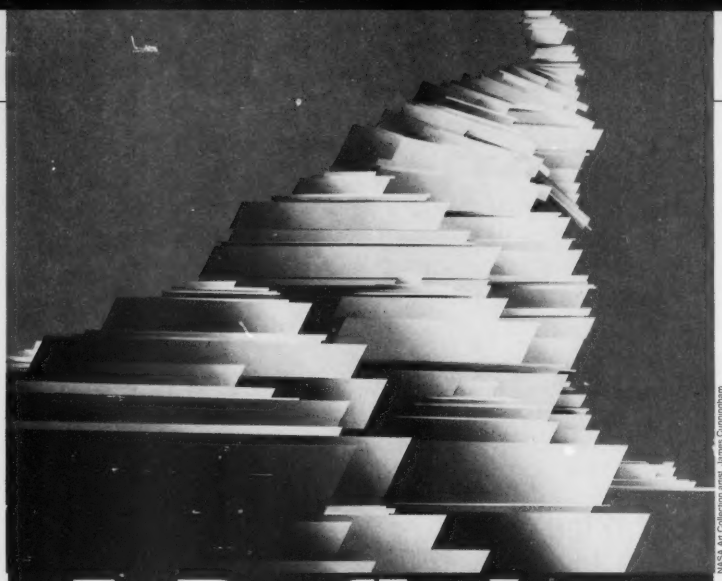
Robert Massof of the Hopkins' Wilmer Eye Institute says that one of the most common complaints of low vision patients is that they cannot distinguish faces properly. "Faces can appear to be blank, with little or no recognizable features." There are other frustrations: Patients may be able to read the title of a book but not the story, or to see tennis players but not the ball. Rickman says that the white paper and black print used by most newspapers and magazines also pose a problem for low vision patients, whereas "If the paper were black and the print white, they would be able to function much better; it would provide better contrast." The space glasses, with their onboard computer processing, could reverse the white and black on the page, allowing the patient to see more easily.

Collaboration on the project began in 1985 when representatives from Wilmer first met with NASA officials to see if they knew of any technology that could help in the institute's work to enhance visual acuity. NASA's Office of Commercial Programs' Technology Transfer Program asked Stennis, with its considerable expertise in the design, fabrication, integration and operation of space sensor systems, to be NASA's lead center for the effort. That's when Doug Rickman, a geologist working in the field of satellite image processing, was asked to manage the project. And asked. And asked again.

Rickman explains it like this: "For various reasons, I turned down the offer to work on the low vision project twice. Then, one Sunday morning in church, the preacher read the story in the Bible about the loaves and fishes; about how someone in the hungry group said there were too many people and not enough food to feed them all. About how it all worked out okay in the end. The preacher said that sometimes we are called upon to do more than we think we can do. I felt I was getting a special calling. It convinced me to take on the project."

And now, Rickman says, he's glad that he did. "This is what we call an enabling technology. It will have an impact far beyond this one application." •

Photos courtesy of Bill Ingalls, NASA Hq., and Johns Hopkins Lions Vision Center.



NASA Art Collection artist James Cunningham

A Defining Moment

by James A. Michener

Renowned novelist James Michener voiced the following thoughts about the exploration of space in his April 28 testimony before the House Committee on the Budget. —*Editor*

Throughout my career, I have given more than a little study and more than a little thought to the patterns of prosperity and decay which have characterized great nations and dominant cultures. I believe destinies are frequently shaped by a "defining moment," and by a society's ability to recognize and capitalize on that moment. I would place in this pantheon Sigmund Freud's analysis of human behavior and Karl Marx's dissection of production and distribution. For any nation to have missed the significance of these powerful movements was to have missed the meaning of contemporary history.

"...I believe that there are moments in history when challenges occur of such a compelling nature that to miss them is to miss the whole meaning of an epoch. Space is such a challenge."

Certainly, the world was changed by that cascade of brilliant industrial inventions produced by England in the late 1700's and early 1800's. We live today on the consequences of that industrial revolution. And I would include our own nation's enviable capacity to finance, organize and manage large industrial corporations.

But history is a grand mix of concepts, actions, organizings and commitments which determines the extent to which any nation can achieve a good life for its citizens. And I believe without question that if a nation misses the great movements of its time it misses the foundations on which it can build for the future.

One word of caution. I am not here speaking of either fad or fashion. I am not extolling the attractive ephemeral. And my experience in the arts has taught me to be suspicious of late fashions or high styles.

But I also believe that there are moments in history when challenges occur of such a compelling nature that to miss them is to miss the whole meaning of an epoch. Space is such a challenge. It is the kind of challenge William Shakespeare sensed nearly four hundred years ago when he wrote:

> "There is a tide in the affairs of men, which, taken at the flood, leads on to fortune; omitted, all the voyage of their life is bound in shallows and in miseries. On such a full sea are we now afloat, and we must take the current when it serves, or lose our ventures."

The space program—perhaps as was crystallized in the moment of Neil Armstrong's epochal "small step"—is the one colossal achievement which may well define our culture much in the way that the pyramids do that of ancient Egypt. We risk great peril if we kill off this spirit of adventure, for we cannot predict how and in what seemingly unrelated fields it will manifest itself. A nation which loses its forward thrust is in danger, and one of the most effective

ways to retain that thrust is to keep exploring possibilities. The sense of exploration is intimately bound up with human resolve, and for a nation to believe that it is still committed to forward motion is to ensure its continuance. Your challenge, the test of your leadership, and I believe the scale with which history will measure your wisdom and insight, is whether you make these achievements a part of a continuum—not merely an historical oddity. To turn away from these initiatives, wholly or in part, from the point of view of a historian, is unthinkable—particularly at a time when the real dividends of space research are only just becoming within reach.

I doubt if there is a woman or man in this room who honestly believes that the United States could ever fall backward, as other nations have within our lifetime. Intuitively, we feel that we are exempt. Yet for us to think so is to fly in the face of all history, for many nations at their apex were inwardly doomed because their will power had begun to falter, and soon their vulnerability became evident to all. Enemies do not destroy nations; time and loss of will bring them down.

Therefore, we should be most careful about retreating from the specific challenge of our age. We should be reluctant to turn our back upon the frontier of this epoch. Space is indifferent to what we do; it has no feeling, no design, no interest in whether we grapple with it or not. But we cannot be indifferent to space, because the grand slow march of our intelligence has brought us, in our generation, to a point from which we can explore and understand and utilize it. To turn back now would be to deny our history, our capabilities.

Each era of history progresses to a point at which it is eligible to wrestle with the great problem of that period. For the ancient Greeks it was the organization of society; for the Romans it was the organization of empire; for the medievalists the spelling out of their relationship to God; for the men of the 15th and 16th centuries the mastery of the oceans; and for us it is the determination of how mankind can live in harmony on this finite globe while establishing relationships to infinite space.

"The sense of exploration is intimately bound up with human resolve, and for a nation to believe that it is still committed to forward motion is to ensure its continuance."

My life changed completely on the day I saw the Viking photographs from the surface of Mars, for I had participated in that miracle. My tax dollars had helped pay for the project. The universities that I supported had provided the brains to arm the cameras. And the government that I helped nourish had organized the expedition. I saw the universe in a new light, and myself and my nation in a new set of responsibilities. My spirit was enlarged and my willingness to work on future projects fortified.

No one can predict what aspect of space will invigorate a given individual, and there must have been millions of Americans who did not even know Mars had been photographed.

But we do know that in previous periods when great explorations were made, they reverberated throughout society. Dante and Shakespeare and Milton responded to the events of their day. Scientists were urged to new discoveries. And nations modified their practices.

We all recognize the hard choices the Congress must make, and the need to address federal deficits and social needs. But as certainly as there are pressing needs of the day, the needs of the future will surely be far more desperate if we do not prepare for them today. To prosper, our children and grandchildren will need new jobs in new technologies, new challenges, and new worlds to conquer. We have no mechanism which transmits this legacy more effectively than our civil space program. All the thoughts of men are interlocked, and success in one area produces unforeseen successes in others. It is for this reason that a nation like ours is obligated to pursue its adventures in space. I am not competent to say how much money should be spent. I am not competent to advise on how the program should be administered. But I am convinced that it must be done. •

Ames

Visitors from the East

A trio of U.S. Senators—John Seymour of California, Ted Stevens of Alaska and Pete Domenici of New Mexico—traveled to Ames last April to tour the center's National Full-Scale Aerodynamic Complex (NFAC). Guided by Fred Schmitz, director of the NFAC, along with center director Dale Compton and deputy Vic Peterson, the senators viewed the world's two largest wind tunnels, which are housed in a facility that has played a key role in the testing of every major advance in U.S. aeronautical and spacecraft design since World War II.

Dale Compton, far right, points in the motor blade area of the wind tunnel during a tour; also pictured from left are Fred Schmitz, Senator Seymour and Senator Stevens.

Seymour praised NASA and Ames for their comprehensive technology transfer programs and for their success in encouraging and developing small and minority businesses. He also took time to chat with a group of children who had completed a day visit to the Ames Aerospace Encounter, a new program dedicated to showing young students the wonder and fascination to be found in science, technology, and mathematics. •

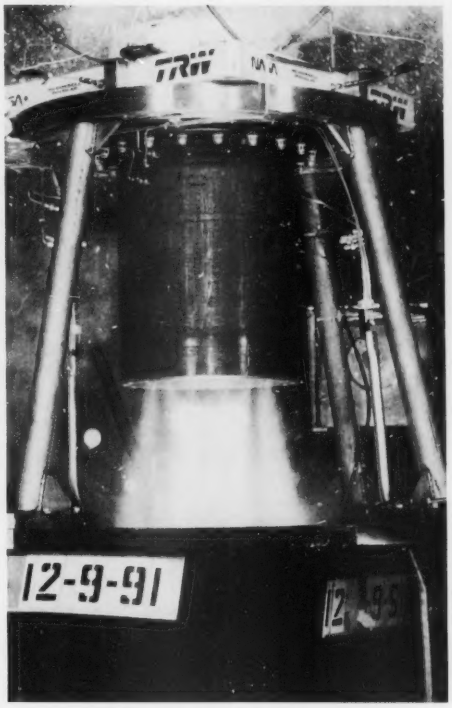
Marshall

Casting Around

Three Marshall labs—the Propulsion Lab, Structures and Dynamics Lab, and Materials and Processes Lab—are using the latest manufacturing technology to design and build an advanced prototype main combustion chamber for future rocket engines. One process being studied is investment casting, which uses wax representations of the part to be manufactured to build up a ceramic mold. The mold is then baked and hardened and the wax is melted out, leaving a cavity in which molten metal is poured. The mold shell is then removed from the metal part.

With current production methods, there are dozens of welded parts in a combustion chamber's main structure that require inspection. With investment casting, the hope is to create essentially a one-piece structure. Not only would this be less expensive, it would cut production time significantly and make inspection easier. •

Lewis



Lewis/TRW successfully test a low cost rocket engine.

Keep It Simple

The Lewis Research Center and TRW Space & Technology Group have successfully completed the first phase of a testing program intended to show that costly high-performance engine components can be replaced by cheaper, simpler technology that still meets mission requirements. The work is part of a cooperative agreement to test concepts developed during TRW and McDonnell Douglas trade studies of low-cost expendable commercial launch vehicles.

The engine tests—known as the Low Cost Liquid Oxygen/Liquid Hydrogen Rocket Engine Demonstration Program—involved firing a 16,500-pound thrust engine at Lewis's Rocket Engine Test Facility. The tests successfully demonstrated the feasibility of using a low-cost injector similar to one used for the Apollo lunar lander descent engines, as well as a low-cost ablative combustion chamber liner. The higher than expected performance, excellent stability, and durability of the ablative material proved that this is an exciting engine concept that may help to lower the cost of access to space. •

Ames-Dryden

International Flyers

Test flights of the X-31 Enhanced Fighter Maneuverability demonstrator aircraft resumed at Ames-Dryden in April. Test pilots are investigating the use of thrust vectoring (directing engine exhaust flow) coupled with an advanced flight control system for close-in air combat at very high angles-of-attack. "Angle-of-attack" describes the angle of an aircraft's body and wings relative to its actual flight path. In combat maneuvers, pilots often fly at extreme nose-high angles while the plane continues to go forward, but at high angles-of-attack a pilot can lose control of the aircraft.

The X-31 international test organization (ITO) is conducting the flight tests at Ames-Dryden to collect data that may apply to highly-maneuverable next-generation fighters. During the next year, an international team of pilots will make as many as 20 test flights a month with each X-31. The planes will then be used for military utility evaluations at the Naval Air Test Center at Patuxent River, Maryland, beginning in early 1993. •

Goddard-Wallops

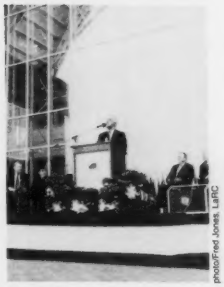
El Coqui

Add Puerto Rico to the list of NASA launch sites: Wallops has established a new launch range on the island's northern coast west of San Juan. The range recently was used for the first time for Project El Coqui (named after a kind of tree frog found in Puerto Rico), a NASA sounding rocket campaign to study the ionosphere, which runs from May 17 to July 13. Scientists from universities, NASA, and other government agencies are studying how the ionosphere responds to artificial perturbations in order to learn more about how it is naturally perturbed. The ionosphere is of interest since it reflects high-frequency radio waves and disturbs satellite signals that pass through it. Students from the University of Puerto Rico at Mayaguez also participated in the project through grants from the Goddard and Marshall Space Flight Centers.•

Langley

Celebrating the Past

The Virginia Air and Space Center and Hampton Roads History Center opened in Hampton, Virginia, on April 5 to an overflow crowd of 12,000 people. Virginia Governor L. Douglas Wilder said at the grand opening: "Virginia has been a pioneer in aeronautics, [with] the first American aeronautical research laboratory, our nation's first Air Force base, the birthplace of the space program, and today the continued research and application of aerospace technology at the NASA-Langley Research Center." NASA's Associate Administrator for Aeronautics and Space Technology, Richard (Pete) Petersen, also attended the opening, saying, "We plan to make this the best aerospace educational center in the nation. While NASA will help with all aspects of the museum, we will pay special attention to the needs of students and teachers and the education which is being put together by the museum and the NASA staff." •



photo/Fred Jones, LaRC

Virginia's governor L. Douglas Wilder at podium; NASA's Richard "Pete" Petersen is pictured at far left.

Goddard

Solving an Old Mystery

U. S. scientists have solved the mystery of Geminga—one of the brightest emitters of high-energy gamma rays in the sky. Geminga, first discovered 20 years ago, had continued to baffle scientists who were unclear about the source of its power and why it shines brightly in gamma rays. Using data from both the Roentgen and Compton Gamma Ray Observatory satellites, scientists from Goddard and Columbia University announced in May, that Geminga's power plant is a rotating, 300,000-year-old neutron star. The scientists observed x-ray pulsations from Geminga that firmly established it as a close cousin of the Crab and Vela nebulae, which also have pulsating neutron stars at their cores. This discovery not only explains the nature of Geminga, but suggests that many of the remaining unidentified gamma ray sources in the Milky Way galaxy also may be neutron stars. The ROSAT and Compton observatories will search for additional members of this emerging class of gamma ray pulsars.•

The more things change, the more they stay the same. In the 1950s, rocketry pioneer Wernher von Braun envisioned a space station that was remarkably similar in spirit and purpose to the station NASA is building today. "Development of the space station," he wrote, "is as inevitable as the rising of the sun."

This year marks the 40th anniversary of Wernher von Braun's provocative series of articles written for *Collier's* magazine on the future of the space program. In honor of the occasion, we're reprinting the following excerpts from "Crossing the Last Frontier," published in *Collier's* on March 22, 1952. Even though von Braun's spinning, wheel-shaped concept differed in many of its technical details from today's configuration, many of his ideas about building a space station were ahead of their time, and they still ring true today. —*Editor*

A Companion in the Skies

by Wernher von Braun

"....Within the next 10 or 15 years, the Earth will have a new companion in the skies, a manmade satellite that could be either the greatest force for peace ever devised, or one of the most terrible weapons of war, depending on who makes and controls it. Inhabited by humans and visible from the ground as a fast moving star, it will sweep around the Earth at an incredible rate of speed in that dark void beyond the atmosphere which is known as 'space'...."

"....In the opinion of many top experts, this artificial moon— which will be carried piece by piece by rocket ships—will travel along a celestial route 1,075 miles above the Earth, completing a trip around the globe every two hours...."

"....When man first takes up residence in space, it will be within a spinning hull of a wheel-shaped structure, rotating around the Earth much as the moon does. Life will be cramped and complicated for space dwellers. They will exist under conditions comparable to those on a modern submarine...."

"....Besides its use as a springboard for the exploration of the solar system, and as a watchdog of the peace, the space station will have many other functions. Meteorologists, by observing cloud patterns over large areas of the Earth, will be able to predict the resultant weather more easily, more accurately, and further into the future. Navigators on the seas and in the air will utilize the space station as a 'fix,' for it will always be recognizable...."

"....The space station's crew will be able to see glaring white patches of overcast reflecting the light of the sun. The continents will stand out in shades of gray and brown bordering the brilliant blue of the seas. North America will look like a great patchwork of brown, gray, and green reaching all the way to the snow-covered Rockies. And one polar cap—which happens to be enjoying the summer at the time—will show as a blinding white, too brilliant to look at with the naked eye...."

"....Development of the space station is as inevitable as the rising of the sun; man has already poked his nose into space and he is not likely to pull it back....."

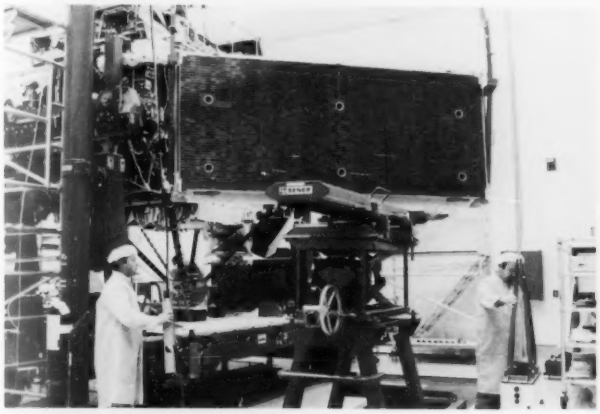
"....There can be no thought of finishing, for aiming at the stars—both literally and figuratively—is the work of generations, and no matter how much progress one makes, there is always the thrill of just beginning...." •

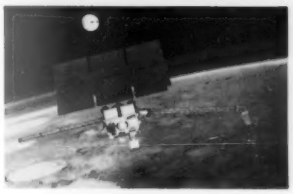
UPCOMING LAUNCHES

• STS-46—the Space Shuttle Atlantis will deploy the European Retrievable Carrier (EURECA) and the Tethered Satellite System (TSS).

• STS-47—the Space Shuttle Endeavour will carry Spacelab-J, a combined NASA/NASDA Spacelab mission.

• The Mars Observer will be launched on a Titan III; this launch will feature the first use of the commercial upper stage, called the Transfer Orbit Stage, built by the Orbital Sciences Corp.





UPCOMING EVENTS

28 AUGUST

WORLD SPACE CONGRESS 1992
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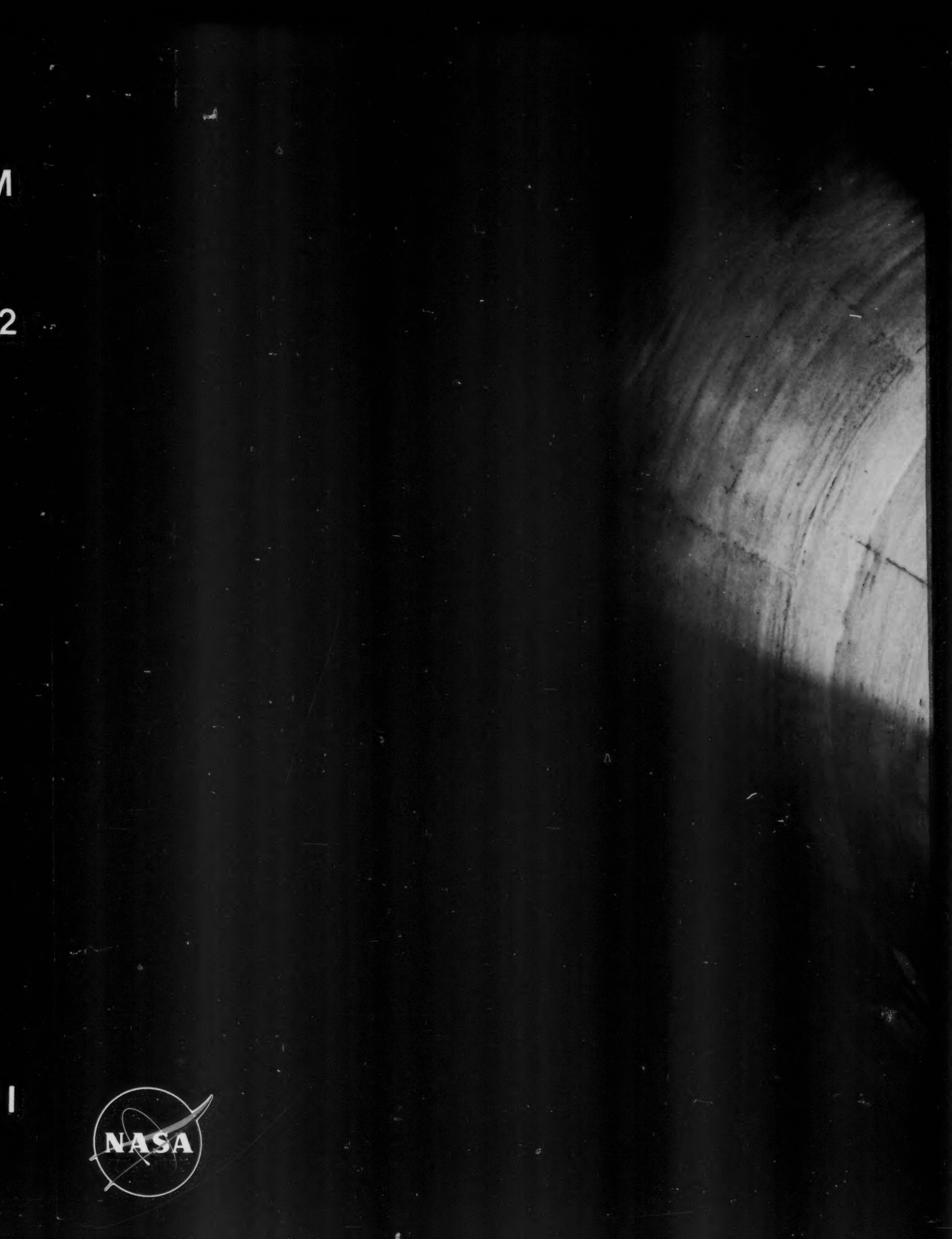
World Space Congress, the 43rd Congress of the International Astronautical Federation, in Washington, D. C., through September 9.

IN OUR NEXT ISSUE

International Space Year—Shaping a global space program.

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